Vo . XXXVI. February, 1909 No. 2.

MUNICIPAL ENGINEERING

A MONTHLY MAGAZINE

DEVOTED TO THE IMPROVEMENT OF CITIES

CONCRETE CONSTRUCTION, PAVING, SEWERAGE, WATERWORKS, STREET LIGHTING, PARKS, GARBAGE DISPOSAL, BRIDGES.

PUBLISHED BY
MUNICIPAL·ENGINEERING·COMPANY
INDIANAPOLIS AND NEW YORK.

LIBRARY OF CONGRESS
FEB 4 1909
SMITHSONIAN DEPOSIT

Registered in United States Patent Office

Two Dollars Per Year. Single Copies, 25 Cents.

Granitoid Pavement

The Superior of All Other Permanent Pavements

ASYLUM STREET, KNOXVILLE, TENN.

The Blome Company Patented Granitoid Concrete Blocked Pavement

A pavement of monolithic construction. Permanently retaining surface grades. Intended for all degrees of traffic. Satisfactorily withstands all climates. Becomes more durable with age. The most sanitary pavement on the market today. The most suitable for street car track spaces. The handsomest of them all. A revolution in permanent pavements.

The foregoing claims are convincingly demonstrated by the pavements (from one to six streets respectively) laid for the following cities and corporations:

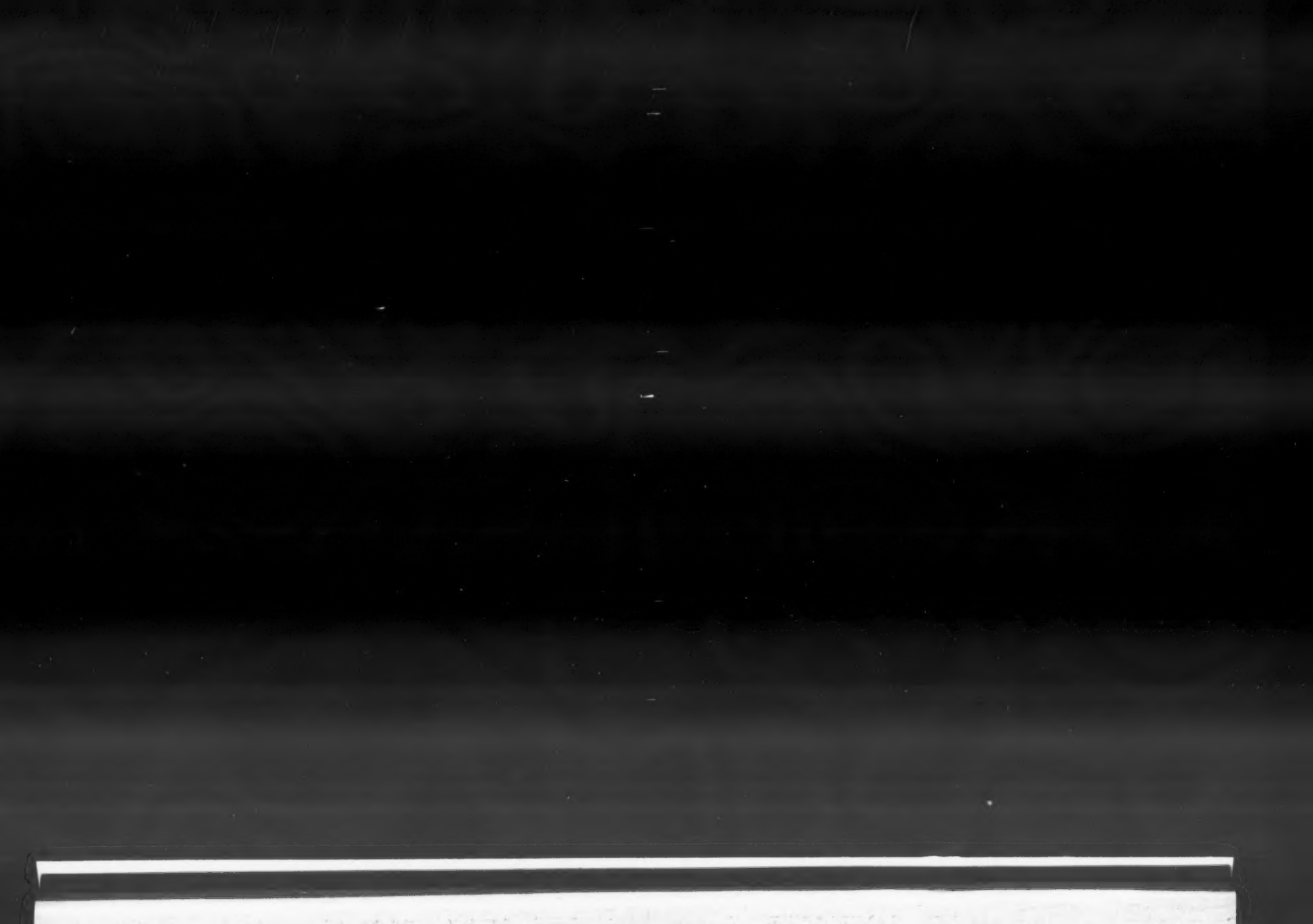
Knoxville, Tenn.; New Orleans, La.; Vicksburg, Miss.; Palestine, Texas; New Haven, Conn.; Boston, Mass.; New Brunswick, N. J.; Kalamazoo, Mich.; Red Jacket (Calumet), Mich.; Hancock, Mich.; Laurium, Mich.; U. S. Steel Corporation, Gary, Ind.; Western Electric Co., Chicago, Ill.; Armour & Co., and other packers at Chicago stock yards, etc., etc.

To those interested we will be glad to furnish further details.

RUDOLPH S. BLOME COMPANY

MAIN OFFICE, UNITY BUILDING, CHICAGO

NEW YORK BIRMINGHAM, ALA. NEW ORLEANS



MUNICIPAL ENGINEERING

VOLUME XXXVI. FEBRUARY, NINETEEN HUNDRED NINE. NUMBER TWO.

THE TONTO PORTLAND CEMENT WORKS, AT ROOSEVELT DAM, ARIZONA.

By Edgar Percival, Los Angeles, Cal.

THE Roosevelt Reclamation Work in Arizona was the first occasion on which a cement plant was constructed for a distinct supply purpose. It was erected in 1903. There have already been used on this work some 300,000 barrels of cement, each of 380 pounds net, at a cost of $1.76 per barrel, whereas that purchased from dealers for preliminary work cost $5.35 laid down on job. The high cost from dealers was the result of the inaccessibility of the location and the consequent high freight and hauling charges. The officials there anticipate, before this work is entirely completed, that quite 500,000 barrels more will be required in the valley work in connection with this project.

This instance has fully proved that it is a decided economy in a big work requiring an amount of cement, to manufacture the commodity in the vicinity, if materials for cement are available in the locality.

Results show that the decision to erect the mills for manufacture of cement at the site of Roosevelt Dam was a wise one, when it is considered that, if the cost of the plant, $120,000, be added to the cost of say only 300,000 barrels of cement, the total cost would figure out but $2.20 per barrel, thereby creating a big saving against purchase cost. After the dam and canals have been completed the cement plant will still be capable of further use and considerable salvage may doubtless be realized.

The cement mill is located on a side hill where the limestone deposit is found. It is about 2,500 feet up stream from the dam site and the lowest floor is 300 feet above the present level of Salt River. This site was chosen in order to have the mill above the water line of the reservoir and free from danger of flooding.

The mill building covers an area 150 feet square and is built in terraces similar to stamp mills, the lowest floor being 60 feet below the highest. The structure is built of structural iron trusses supported by wood columns, and the galvanized corrugated iron roofing is laid on wood purlins. Fig. 1 shows the plant above, a temporary power house below, and a suspension bridge over the Salt River.

On the highest terrace are bins for the storage of rock and clay, into which these materials are dumped from cars hoisted by electrically driven drums. From the rock bin the limestone is spouted to a No. 4 Gates crusher, which delivers it crushed to a Smith automatic feeder, regulating the feed to a rotary dryer below. From the dryer the limestone is elevated and conveyed by a drag flight cable conveyor to a storage bin above a ball mill. From the ball mill the dried, crushed and ground rock is delivered into a bin. The clay is passed through a similar process, going from bin to crusher, then to feeder and rotary dryer, then by drag conveyor to Sturtevant mill, then to storage bin alongside the ground limestone bin.

The materials are mixed at this point and then conveyed to a pebble mill and from that mill to a reinforced concrete storage bin. From the storage bins the raw material is fed automatically to the kilns. The clinker is delivered from the kilns into a rotary cooler and this delivers it to a bucket elevator that spouts it into a vertical tower for storage, preparatory to grinding in a ball mill. After passing

through a ball mill the cement is finally ground in a pebble mill and then elevated by bucket elevator and spouted onto a belt conveyor that delivers it to a series of storage bins from 50 to 100 feet away.

A feature of the manufacture that will be considered important by some engineers is that no plaster or gypsum is added to the cement to regulate the setting time.

The cement is to be used in the waters of Salt River, which carry 368 parts sodium chloride to 100,000 of water, or 10 per cent as much as sea water carries. In order that the concrete shall be less liable to action from the salt water, the addition of plaster is omitted and the regulation of the setting time is attained by making a cement with somewhat low content of alumina; indeed, the cement is slower setting than many cements carrying gypsum.

The omission of plaster is considered of much greater importance than high tensile tests for short periods. The cement shows a high ratio of increase in strength in long time periods.

Each ball and pebble mill and line shaft is driven by a belt-connected alternating current motor. Each mill has a clutch pulley so that the load can be eased on the motor. The motor and belt are enclosed in a room with expanded metal plastered walls, to prevent the dust destroying the insulation of the motor windings. There are six motors altogether: Two 100-h. p. motors drive the pebble mills; two 50-h. p. motors drive the ball mills; one 50-h. p. motor drives the kiln line-shafts; one 75-h. p. motor drives the crusher line-shafts.

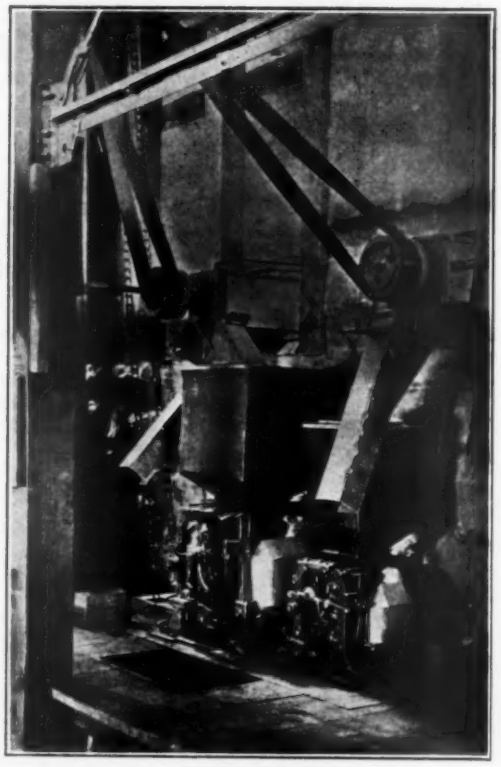
Compressed air is piped into each motor room for use in blowing out the dust from the motors. This is done daily.

The large storage provided for raw mixture and clinker admits of running the plant by stages. This was a consideration during the first six months of operation, when all the power available was from one 150-h. p. and one 30-h. p. engine. Wood was used as fuel in the boilers.

It was desired to make several thousand barrels of cement for use in plastering the canal, preliminary to the completion of the water power plant, when abundance of water power was available at only the cost of operating the plant, thus greatly reducing the cost of manufacture.

The method pursued to get a uniform raw mixture is unique and unusual in current practice. Crushing, drying and partially grinding the rock and clay separately and then storing these prepared materials in separate bins, permits of their analysis and accurate proportioning before they go through a mixer and pebble mill for final preparation. This method involves duplicating the crushing, driving and coarse grinding machines, but it insures that the raw mixture shall not vary in the lime constituent more than 5-10 of a per cent per day. The writer knows of no other plant in the United States where so uniform a mixture is secured. This is the most rational method for making a standard

PORTLAND CEMENT WORKS AT ROOSEVELT DAM, ARIZONA.



PORTLAND CEMENT PLANT AT ROOSEVELT DAM, ARIZONA.
Tandem Weighing Machines for Raw Materials.

and controllable mixture. The bin above the ball mill has a capacity of twenty-four hours run of dried, crushed limestone. The bins below the ball and rock emery mills have storage capacity for twelve hours run of dried, coarse-ground limestone and clay. The storage bin between the pebble mill and kiln has a capacity of five days run of prepared raw mixture. The rock bin has a capacity of 200 tons, and the clay bin alongside a capacity of about 100 tons.

The car track is raised by trestles above the bins, and in the lengths over the bins one rail is higher than the other, to facilitate dumping the cars. By means of wire cables and double-drum electric hoist, the rock cars are hoisted up a grade of 34 per cent from the quarry about 600 feet distant. As the car reaches a point above the rock bin, the spring latch at one end is released by a bumper, causing the hopper of the car to dump. Then the car, without righting the hopper, is allowed by the hoist engineer to return to the quarry for reloading. The cars of clay are hoisted and automatically dumped in the same way. Only one man, the hoist engineer, is required to hoist, unload and return the cars.

The bins are self-emptying to the rock and clay crushers below. The cars go around a curve of 50 feet radius at the upper corner of the mill, on a grade of 34 degrees, where the cable is kept on the curve by sheaves spaced 5 feet. This arrangement operates satisfactorily.

Two outfits for proportioning the dry, ground limestone and clay have been installed. Thus far this has been done with a bucket suspended from a steelyard of 600 pounds capacity. The charge of limestone is first weighed, then the proper amount of clay is added and the whole is dumped into a hopper delivering to a cut-flight mixing screw-conveyor that conveys it to the hopper of the pebble mill. One man weighs six tons hourly with this equipment. The small weighing charges facilitate proper mixing.

There has also been installed a tan-

dem automatic weighing machine, one machine having a bucket of two-thirds bushel capacity for clay, and another with a bucket of 2 bushels capacity. (Fig. 2.) Together they are expected to weigh ten tons of rock and three tons of clay hourly. Some improvements are needed in these machines to make them operate successfully.

The bottoms of the brick dust-chambers at the upper ends of the kilns have coppered bottoms, with chutes to spout all raw mixture collected there into a screw conveyor that discharges into the mixing conveyor underneath the weighing apparatus.

The rotary clinker cooler is lined with brick, has a cast-iron grated head at the delivery end and is designed to cool, break up and mix the clinker, as well as heat an exhaust air blast used in the kiln burners and rotary dryers.

To prevent the danger of the millers being caught in the gears, and to exclude dust from them, all gears of ball and pebble mills have removable galvanized iron casings over them.

The ball mill grinds five and one-half tons of limestone an hour to a fineness of 50 per cent through the 100, and 25 per cent passing through the 200 mesh, and with a charge of 4,700 pounds of balls. The speed is 23 r. p. m.

The other ball mill reduces three tons of clinker as it comes from the kiln and cooler to a fineness of 50 per cent passing a 100-mesh screen. The charge of balls consists of 385 balls, as follows: 105 18-pound balls, 125 13-pound balls, 155 8-pound balls. Total weight, 4,905 pounds.

This mill has 27-mesh screens on it. The speed is 23 r. p. m.

The mixture of ground rock and clay is put through the pebble mill at a rate of six tons an hour, and is ground to a fineness of 84 per cent passing a 200-mesh screen. The speed of the pebble mills is 25 r. p. m.

The cost of materials for the plant was as follows:

All cement mill machinery listed in the specifications, $38,798 f .o. b. cars Chicago. The mill building erected for $11,893. The lumber for columns and purlins, furnished by the Government. Motors, $10,631; the 1,000-k. w. and 150-k. w. generators, $11,375, and the water wheel and governor, $8,445. The Government paid the freight and hauling charges on all the materials except on the structural and corrugated iron in the building.

The plant was designed by E. Duryee, cement expert of the Reclamation Service, and drafted by former Assistant Engineer R. P. Dillon in the summer of 1903. Bids on the materials were received at Denver, September 21, 1903. The contracts were signed in March, 1904. The first shipments of machinery were made April 26, 1904, and the last shipments December 6, 1904. The plant was ready to commence making cement in February, 1905, so that about nine months, or from July to March, were occupied in its erection. This is as quick work as is customary in works erected in the East under much more favorable conditions.

Mr. F. H. Newell was chief engineer and Mr. A. P. Davis assistant chief engineer, and Mr. L. C. Hill supervising engineer of the Reclamation Service during the period of its erection. The machinery was installed by the Government with day labor under the supervision of the designer.

COST OF CONCRETE CONSTRUCTION AS APPLIED TO BUILDINGS.*

By Leonard C. Wason, President Aberthaw Construction Co., Boston, Mass.

THE writer is going to give in the course of this paper some actual job costs of various parts of building construction from his own experience. This kind of data is usually guarded with the greatest of care from every interested or curious eye outside the firm possessing it and often even from the trusted employee of the company. It is information usually known only to the manager of owners of a construction company and kept by them under lock and key.

It is not pure philanthropy on the writer's part to publish these cost data. If the selfish business motive is stated for so doing, perhaps more confidence may be placed in the figures

*A paper before the National Association of Cement Users.

given. Granolithic pavements have been so long in use and so many contractors have laid them that their cost is a matter of common knowledge not only to all cement users but to the interested investing public. The result is that any contractor bidding a living profit above the actual cost of construction has a fair show of winning the job, and the lowest bidder will usually make a profit. The same is true of building construction with brick and wood. Not so, however, is the case with concrete building construction. The art is too new to have methods or even designs standardized sufficiently to permit of cost data for

EXTERIOR OF REINFORCED CONCRETE FACTORY.

present methods being very generally known. A great many builders are taking up this type of construction at the present time, some who are competent, many who are not. The novices under-estimate the cost and difficulties of doing good work, hence they bid unreasonably low, lose money, and to some extent demoralize the true value of proper workmanship among architects, engineers and their clients. In the writer's opinion there is no class of construction where more painstaking skill and often technical knowledge is required than in reinforced concrete. When well done the resulting building is satisfactory to the owner beyond one constructed of any other material, and when poorly done is the least desirable, even if not actually dangerous. Concrete is either good or bad. There is no half way state, and the difference in cost of materials to the builder between perfect results and a dangerous structure is only five per cent. Therefore there is likely to be serious injury done to a rapidly growing industry by novices either on account of ignorance, though coupled with honest, well meaning intent, or through skinning a job on which he is sure to lose money. Moreover, the older firms in the field have little to fear from the beginner because so much depends on personal ability as well as experience. With growing competition, improvements are constantly being developed. The standard of cost is not yet fixed but is being reduced steadily. The desire of reducing the present wild bidding and having only intelligent competition as well as saving some poor builder a loss he cannot afford is the real inspiration of this paper. The author has undertaken it with the understanding that other competent writers would discuss it so that a greater good will result.

In order to have an intelligent understanding of the meaning of the figures hereinafter given, the method of collecting data will first be described.

When making up an estimate of the cost of a building, in scaling the plans, it is found convenient to take off the volume of excavation and backfilling, the cubic feet of footings, foundation and wall, the square feet of forms for walls of foundations and above grade, the lineal feet of belt courses, moldings, cornices, etc., also the superficial area of column and floor forms are measured by themselves. Concrete of each different mixture is scaled off in cubic feet and totaled separately. Steel of each kind is taken off in pounds, granolithic finished surfaces in square feet, and so on in detail every item is measured.

As the work progresses it is desired to know weekly how the actual experience compares with the estimate and at completion to compile correctly the costs of each item to compare with estimate and to aid in obtaining the true cost of future structures of a similar kind. The method of accounting was developed to fit the estimate.

In the year 1898 daily time reports were designed having a number of columns for ease in sub-dividing the time of the workmen. At the head of each colum the timekeeper puts index numbers or letters to show the kind of work being done and below the actual time the men worked. On blank spaces at extreme right of the report the timekeeper inserts in writing the amount of each kind of work done and the amounts of the principal materials used. The experience of eight years has required no change whatever in the principles first adopted. The only change in the forms has been to increase the number of vertical columns so that a larger number of sub-divisions can be used without troubling the timekeeper to re-write the names on another sheet. At the present time ten vertical columns are used for recording time with the names of the workmen at the extreme left, two columns being left at the right for the rate per hour and the total amount. At the beginning of a job, written instructions are given as to how the work is to be subdivided into items in the reports. A standard method of classification has been adopted as follows:

The principal sub-divisions are given a capital letter. Thus everything whatsoever relating to concrete masonry is given the index letter M; excavating of all kinds, including work incidental thereto, the letter D; all work connected with plant the letter F; and so on, there being only six or seven sub-divisions to indicate every building operation. To indicate the kind of work vowels are used. Thus the vowels beginning with "a" all relate to form work, as: "a," centering complete; when done by separate operations "aa" is making, "ae" is setting, "ai" is straightening up or bracing, "ao" removing after being used, and "au" cleaning up and handling ready to be used again. All labor connected with mixing and placing concrete or with handling materials for same goes under the head of "e." All work in connection with plant, receiving, erecting, taking down, shipping and repairing is indicated by the vowel "i." Thus "i" means receiving and setting up plant ready to work, "ia" taking down, removing and shipping, and "ie" repairing. The consonants are used to indicate different parts of a structure in which certain work is done. Under classification "M," "b" stands for footings, "c" columns, "d" foundations, "f" floors, "g" stairs, etc. Under classification "P," "f" stands for boiler, "g" for horizontal engine, "h" for vertical hoisting engine, "l" for elevator, "m" for mixer, etc. Thus our timekeeper places at the head of a column when he is reporting concrete floors, for the placing of forms "Maaf," for concrete "Meaf." If a mixer is being set up ready to work, the report would read "Pim" and later if it was repaired it would be reported under "Piem," etc.

This is not so complicated to use as it may appear to read, and experience has proved that every man who knows enough to keep time can use the system with a few days experience. The principle is to make the least amount of clerical work to the timekeeper on the job, as they have plenty of other work to do.

In addition to sub-division of time as above set forth, it is the duty of the timekeeper to report the number of barrels of cement mixed in a day, which is usually done by the man in charge of the mixer counting the empty bags, and in addition the actual volume of concrete measured in place. From this, knowing the proportions, it is a very simple matter to obtain the amount of sand and stone used and also to see if the right amount of cement is being used.

Carpenter work on forms is reported by the number of square feet of surface in contact with the concrete erected. Thus walls are measured two sides without deducting doors and windows, as it is usual to let the form work run straight across these unless it is impossible on ac-

count of moldings, in which case the framing of the opening will cost as much as the form work omitted. Beam floors are measured around the perimeter of the beam and the flat surface of the panel and around the perimeter of girders. No deduction is made for the loss of area by the intersection of beams and girders, and small openings in the floor are not deducted. Anything as large as an elevator or stairway is usually deducted. Form work for columns is measured for entire area of surface contact between wood and cement, all four sides.

These reports are made out on the job daily and sent to the office. The book-keeper works these reports up into units of measurement, as cost of labor per cubic foot of concrete and number of cubic feet of concrete per barrel of cement, number of square feet of form work erected, etc., and from this it is easy to obtain the unit costs hereinafter given. The book-keeper can take the reports of four or five jobs, employing in the aggregate five or six hundred men, and in a single day work up the complete report for a week's time. Thus it will be seen that there is really little extra labor involved in the sub-dividing of reports into a useful form over merely reporting the time so that the payroll can be accurately made. The system employed has appeared of sufficient value to others to warrant its being briefly outlined in books and magazines.

Materials received on the job are reported on cards especially printed for the purpose, listing the principal materials which are reported, in order to save work of the timekeeper in reporting materials accurately.

When a job is entirely completed and the ledger account is closed, a master card is worked out giving the complete history of the cost. On one side of the card are written the items which went into the original estimate, such as excavation, back-filling, footings, foundations, columns, floors, walls, stairs, etc., etc. In parallel columns are placed the actual amount of the estimate with the actual experience reduced to cost units, such as cubic feet, square feet of form work, etc., and the percentage of profit or loss between the estimate and actual results. On the reverse side of the card the principal items are worked out more in detail. Thus form work is reduced to cost of labor, lumber and nails, wire or other sundries used in the forms per square foot of surface. Concrete is itemized into the superintendent's general labor, labor of mixing and placing, cost of cement, sand, stone, miscellaneous expenses such as teaming, plant and other general items, reduced to cubic foot measurement, which makes the total cost of the concrete in place in each division of the building, itemized for ready reference when making up future estimates on work of a similar character.

It is well known that the cost of materials and labor in different parts of the country varies somewhat. Having the unit items all sub-divided as above stated into their elementary parts, it is an easy matter, after determing the cost of materials in any locality, to make the exact corrections to the results obtained on a previous job; similarly, when a difference in the rate per hour for wages is known, if the same efficiency is obtained from the men it is very easy to make a correction, or if the efficiency varies, judgment must be applied to determine the correct rate to use. It has been the writer's experience that although the rate of wages and cost of materials vary somewhat in different parts of the country, the variations frequently offset one another so nearly that the sum total of the unit cost obtained in one place may be used in another, very seldom needing correction. For instance, within one month, after careful investigation, a bid was made up on a structure at San Juan, Porto Rico, using the same unit costs as for a building in Boston. In the report that is given, the costs relate to strictly first class material and workmanship in every case, as it has been the endeavor of the writer to establish and maintain one standard for all work.

The variations in cost due to different mixtures of concrete can easily be allowed for by reference to the table on page 133 of the Proceedings of the Fourth Annual Convention of this Association. In general I would say that the standard mixture for all floors has been either 1-3-6, or 1-2-4 if the floor is subjected to extremely heavy loads and service. Walls are mixed 1-3-6 and columns usually 1-2-4; in some cases where they are very heavily loaded a richer mixture is used. As these mixtures are common to nearly all construction the costs here given may be applied with little danger of error from neglecting the mixture on any work.

Of course it can readily be understood that in the large number of jobs which have entered into the averages

given, there being as many as eighteen in the case of beam floors, different methods of conducting the work have been used and many different foremen. Therefore, while the general average is doubtless safe for any work of an average character, some latitude may be allowed the judgment in determining whether any specific case is likely to be difficult, easy or average. The writer has found quite a difference, for instance, in cost of identical work handled by different foremen, due to the personal equation of their painstaking, supervision and ability.

In the following tables only typical jobs are given, whose results are correctly known. The results of a number of jobs have been spoiled by a change of timekeeper during the progress of the work, the new man missing for a day or two the proper classification or some other such small matter. It appears to the writer, moreover, that the results from a few typical jobs would be of more interest than a mass of figures from all kinds, some of which would be of no value. Enough are given for a fair average, except in the case of long span flat slab, which is, by comparison, a recent type of construction. The figures for the highest, lowest and average totals in the fourth and last columns are taken from the vertical column in which they stand and have no relation to the other figures in their horizontal line.

SUMMARIZED RECORDS OF VARIOUS CONTRACTS.

Basis of Summary.	Forms per Square Foot. Carpenter Labor.	Lumber.	Nails and Wire.	Total.	Concrete per Cubic Foot. Concrete Labor.	Gen'l Labor.	Cement.	Aggregate.	Team and Misc.	Plant.	Total.
CONCRETE COLUMNS.											
Highest	.133	.082	.002	.181	.166	.056	.109	.084	.041	.034	.340
Lowest	.057	.013	.001	.075	.064	.003	.062	.027	.008	.013	.271
Average of 9	.082	.036	.001	.130	.096	.027	.085	.049	.021	.023	.301
BEAM FLOORS OF REINFORCED CONCRETE.											
Highest	.165	.107	.004	.275	.186	.035	.194	.101	.052	.055	.470
Lowest	.037	.027	.001	.067	.047	.004	.071	.037	.007	.010	.202
Average of 18	.070	.045	.002	.116	.111	.020	.106	.063	.025	.024	.354
FLAT SLAB FLOORS.											
Highest	.078	.039	.003	.118	.146	.017	.109	.084	.026	.039	.374
Lowest	.067	.037	.001	.106	.043	.004	.087	.053	.012	.010	.252
Average	.071	.038	.002	.111	.097	.009	.096	.070	.019	.024	.315
CONCRETE SLABS BETWEEN STEEL BEAMS.											
Highest	.110	.071	.003	.184	.144	.048	.208	.080	.064	.046	.428
Lowest	.028	.012	.001	.049	.073	.005	.076	.026	.004	.010	.272
Average	.061	.032	.002	.095	.102	.019	.128	.068	.024	.017	.359
BUILDING WALLS ABOVE GRADE.											
Highest	.136	.073	.005	.176	.146	.052	.105	.187	.077	.055	.446
Lowest	.046	.016	.001	.079	.042	.004	.034	.043	.007	.005	.174
Average of 17	.085	.036	.002	.128	.090	.016	.073	.076	.025	.019	.301
FOUNDATION WALLS.											
Highest	.134	.048	.004	.193	.213	.037	.203	.116	.057	.040	.599
Lowest	.032	.009	.001	.056	.040	.002	.038	.027	.003	.010	.148
Average of 14	.068	.033	.002	.103	.076	.015	.080	.062	.019	.017	.269
FOOTING AND MASS FOUNDATIONS.											
Highest	.119	.077	.003	.198	.081	.020	.098	.099	.013	.049	.275
Lowest	.016	.006	.001	.018	.025	.001	.047	.043	.003	.010	.181
Average of 10	.057	.034	.002	.093	.045	.007	.071	.077	.007	.021	.229

STEEL.

Highest (cost per ton)	$16.47
Lowest (cost per ton)	2.54
Average of 21 (cost per ton)	8.52

By reference to the general averages on form work in the foregoing tables of forms per square foot of surface contact, namely, columns $0.13, floors with reinforced concrete beams $0.116, flat floors without beams $0.11, the writer believes all higher in price than usually believed to be a fair cost by the majority of builders. It is upon the success of handling forms that good results financially depend.

In regard to concrete, labor is the variable item which must be carefully considered. Anyone of intelligence can make a careful estimate of the materials to be used, but note the average prices per cubic foot of labor, namely for columns $0.123, beam floors $0.131, flat floors $0.100, floors between steel beams $0.121, walls $0.106, foundations $0.091, and mass work in connection with buildings $0.052; not until the last item is reached is a price obtained in experience which, accordshort span slabs between steel beams including the fireproofing on the sides of the beams $0.095, walls exposed to view above ground $0.128, foundation walls $0.103, mass foundations $0.093,

INTERIOR OF REINFORCED CONCRETE FACTORY.

ing to the observation of the writer, the majority expect to obtain in building work in general.

Many men who have had wide experience in handling large quantities of concrete in mass have at times attempted a lighter type of construction and been greatly surprised at the large expense connected therewith. It has come to the writer's notice a number of times that men with this experience have added 50 to 100 per cent. to the cost of mass work and felt that they were amply covered for light structural work. The fallacy of this can be seen by a very recent experience of the writer.

In building a dam this past year across the Connecticut river about 5,500 cubic yards of concrete were placed. Cement and aggregate were received on a bridge abutment 26 feet above the river. Aggregates were dumped upon an inclined chute where they were to be washed, and from the end of the chute they fell into bins, from which they were thrown through measuring hoppers into a mixer and dumped from this into tram cars four feet above the water. The total expense for labor of washing, charging, mixing and dumping into the cars was only $0.12 per cubic yard, and for moving it in cars an average distance of 700 feet, dumping and placing was only $0.30 per cubic yard, or a total cost of $0.0155 per cubic foot.

The table of steel omits entirely the first cost of the material. After it is received at the site of the work in the shape sold by the manufacturer, these prices cover the cost of fabricating into units for columns or beams, bending the stirrups, placing, and all incidentals whatsoever prior to the actual embedding in concrete. In the case of the highest cost, a coal pocket, there was very limited storage space, 1½ inch bars had to be bent diagonally so as to pass over the top of the support at columns, and numerous stirrups, all of which had to be made by hand. The job was too small to justify any mechanical arrangement for bending or for handling material. The next highest, office building, Portland, Me., there was a sufficient amount to require proper machinery. The hoops

for columns were all welded. The vertical bars were all wired inside of these hoops. There was a mushroom head of bent and circular bars wired together at the top and great numbers of long bars of small sections spread in all directions over the floor. The lowest price, filter at Lawrence, was made entirely of straight bars placed loose, the only expense being cutting them in a hand shear to length and placing them.

In the exhibit at the end is given an exact copy of a "master card" which gives the complete financial history of the job when it is finally completed. Photographs of this particular building are given for aid in understanding the explanation. The first column, which is blank, is occasionally used for an estimate of the first cost, the proposal including the profit as well as the estimated actual cost.

It will be seen that on some items a loss was incurred, as well as a profit on others, showing that it is difficult, even on work which a company is fairly experienced on, to reach the right price on everything, and also that when slight changes are made by the owner or architect they often entail heavy loss even though the changes appear to be extremely trivial. Take the case of the external walls. The owners furnished the window frames and sash, which were all of metal. The original design was for a frame with two sash, which could easily be put into a 6-inch wall. They later decided, for greater fire protection, to use four sash. This required an 8-inch wall instead of 6-inch, and the form work on the inside had to be built inward and then the space under the windows paneled to save material. To save making a very narrow panel at the side of the window, which would cost more than the concrete saved, the space was filled up solid so that the columns appear to be wider than they were actually figured. This slight change, which did not appear great at the time, when the job was entirely complete showed that the concrete on the walls showed an actual loss instead of profit and that the

MASTER CARD FOR JOB No. 747.

Date, May 24th, 1906. Mill, Tappan Bros., Attleboro, Mass.

	Proposal.	Actual cost.	Per cu. ft.	Profit.	Loss.	Per ct.
Total	$35,164.55	$31,330.48	.....	$3,834.07	.....	11
Excavate	790.00	823.18	.021	.....	$33.18	
Footings and Foundation..	1,738.00	1,033.57	.137	704.43	.....	
			Sq. ft.			
Exterior Walls.....	1,955.00	2,162.02	.190	.....	207.02	
Wall and Fn. Centers....	1,520.00	3,630.08	.125	.....	2,110.08	
Floors 6⅝ in. thick.....	8,883.00	6,544.16	.339	2,338.84	.....	
Roof 5¼ in. thick.....	2,869.00	1,713.51	.237	1,155.49	.....	
			Lin. ft.			
Columns 20x20 in.....	832.00	676.65	1.470	155.35		
Stairs	883.00	910.35	.912		27.35	
Tool Surface	469.00	636.53	.056 per sq. ft.		167.53	
Ornaments and Cornice...	348.00	164.33		183.67		
Ventilators on Roof.....	44.00	35.64		8.36		
			Each.			
Set Wind's & Door Frames	852.00	729.99	2.19	122.01		
			Sq. ft.			
Interior Partitions	1,770.25	1,656.35	.189	113.90		
Bolts and Iron Works.....	253.00	257.06			4.06	
Stair Railing and Grill....	387.00	654.00			267.	
			Per M.			
Screeds and Setting.....	1,086.00	835.12	52.17	250.88		
2-in. Spr. Plank & Laying.	2,839.00	1,431.69	33.30	1,407.31		
⅞-in. Maple Plk. & Laying.	1,738.00	1,788.88	89.44		50.88	
Motor Shaft	379.50	533.19	98.89		153.69	
Motor Shaft Foundation....	98.00	70.07		27.93		
Roofing and Conductors...	1,255.00	1,026.06		228.94		
			Sq. ft.			
Paving	1,009.00	647.54	.094	361.46		
Retaining Wall						
Centers, per sq. ft....			.211			
Concrete, per cu. ft...	429.00	316.90	.175	112.10		
Painting	400.00	375.00		25.00		
Steel Footings and Walls..	300.00	218.91		81.09		
Plant, Freight, etc.....	1,860.00	2,271.73			411.73	
Bond	100.00	120.00			20.00	
Extras	77.80	67.97		9.83		

form work cost more than twice what was originally estimated that it should cost.

Regarding the tooling of wall surfaces, we originally planned to do this when the cement was less than ten days old, but on account of the various changes forms had to be left on a considerably longer time and it was inconvenient to tool the surface until the cement was so thoroughly set that the cost of dressing was considerably greater than was first anticipated.

Again, by reference to the ⅞-inch maple floor which was placed upon the concrete construction, a cost of $89.44 per M. bd. ft. will be observed, and by reference to the details on the back of the card it was seen that repairing floor cost $248.80, or $12.42 per thousand. This was due to the fact that the owners did not deliver or set the window sash at the time agreed and therefore the maple floors lay exposed to the weather in the building for several weeks, swelled and after laying shrunk, leaving large cracks which the owners insisted on being filled before they would accept the work. These indicate how matters which appear trivial at the time may cause serious loss if overlooked.

As seen by the large list of items entering into the estimate as given by this master card, there are various items of cost entering into the construction besides those which are enumerated. Nevertheless, the matter of the forms, steel and concrete covers by far the largest proportion of the cost of a reinforced concrete structure and the minor items are those which are peculiar to each individual case and which any person can easily estimate for himself.

SOME SEWER GAUGINGS.*

By Delmar E. Teed, City Engineer, Cadillac, Mich.

THE sewage from the city of Cadillac is discharged into a small river, which forms the outlet of Lake Cadillac. This river frequently dries up during the summer months and the sewage causes a nuisance which has been the cause of some complaint among the recent settlers along the river. To remedy this condition, the City Council during the winter of 1906-7 decided upon the construction of sewage purification works. As it was suspected that the consumption of water was quite large and that a considerable portion of it reached the sewers, the City Council directed the writer to measure the daily discharge of the sewers. Some of the methods of obtaining this information as well as the data themselves may be of interest.

The first sewers of the city were constructed in the year 1881. At present our sewerage system covers about one-third of the area of the city and over 3,000 persons, or approximately one-third of the population, are making use of them.

The sewers discharge into the river in three different places, these outlets being through pipe of 6-inch, 12-inch, and 18-inch diameter. The 6-inch pipe receives the sewage from one of the school buildings of the city and also from about half a dozen small residences. As school was not in session during the week when the gaugings were made and the discharge from the residences proved too small to measure with our apparatus, no further account will be taken of this outlet.

The 12-inch pipe receives the sewage from a small territory which is too low to be discharged into the main system. This sewer is in no place more than 10 feet above the lake and serves 475 persons. This 12-inch pipe follows along the bank of the river for about 1,500 feet, with a fall of only 21 inches, and in times of high water is entirely submerged. As the water was exceptionally high during the spring of 1907, it was necessary to wait until the latter part of June before readings could be commenced.

The 18-inch pipe receives the sewage from the larger part of the city and serves only 2,517 persons. It discharges into the river near the city limits at a distance of about half a mile below the 12-inch outlet. This 18-inch pipe has been recently connected with the sewage purification works, which were constructed during the past summer.

On the 26th of June, 1907, the water in the river having lowered sufficient-

*A paper before the Michigan Engineering Society.

ly, the gauging apparatus was fastened into the ends of the 12-inch and 18-inch pipes and the gaugings were commenced at 4 o'clock p. m. The readings were taken every hour at the 12-inch outlet and twenty minutes later at the 18-inch outlet, and were continuous night and day for seven days.

The apparatus for taking the gaugings was suggested by Mr. Geo. S. Pierson, C. E., Kalamazoo, Mich., and was made in a local tinshop. The 18-inch apparatus was made as follows, and the 12-inch differed only in size: A circle 20 inches in diameter was cut from a sheet of No. 16 galvanized iron, and to this was fastened a 3-inch flange having a diameter of 17½ inches. In the center of the circle an orifice 4 inches wide and 6 inches high was cut and covered with a sliding door. The width of the orifice remained constant, but the height was adjusted by sliding the door up or down. The size of the opening thus produced was measured on a scale painted on the slide. The size of the orifice was so adjusted as to cause the sewage to back up to a height of two or three feet. In order to measure this head, a ¾-inch hole was made in the iron plate a little distance below the orifice, and a ¾-inch iron pipe, 3 feet in length, was attached on the inside and a garden hose having a glass tube in the end was attached to the outside. The hose could be raised or lowered until the height of the sewage was visible in the glass tube. In order to hold the apparatus in position in the end of the pipe against the water pressure it was found necessary to attach a couple of wooden blocks to the face of the iron plate and brace a couple of sewer screws against them. In taking the readings the operator read off the height of the orifice from the scale attached and then measured the head by first setting a measuring rod on one of the wooden blocks, the height of which above the bottom of the orifice had been previously determined, and then, by raising or lowering the hose, the surface of the water could be made to appear in the glass tube held against the measuring rod. The size of the orifice at the 18-inch outlet was kept constant at 0.334x0.422 feet during the entire seven days, but it was necessary to change the orifice at the 12-inch outlet several times in order to keep the head within such limits that it could be read from the glass tube.

From the readings thus obtained the quantity of sewage was computed by the following formula, found on page 121 of the eighth edition of Merriman's Hydraulics:

q equals cbd times the square root of 2gh, in which

c is the co-efficient of discharge, which for this work was taken as 0.604,

b is the width of the orifice,

d is the depth of the orifice,

g is acceleration due to gravity,

SEWER GAUGING APPARATUS.

GAUGING A 12-INCH SEWER.

h is the head on the center of the orifice.

q, the quantity, is given in this formula in terms of cubic feet per second, but by multiplying by 7.481x3600 the results were reduced to gallons per hour.

The discharge as thus computed for the 12-inch and 18-inch pipe is plotted on the accompanying diagram. These gaugings show that during the seven days 1,203,086 gallons of sewage were discharged from the 12-inch outlet, and 3,534,393 gallons were discharged from the 18-inch outlet.

It also shows for the 12-inch outlet a minimum of 5,256 gallons per hour on Friday, June 28, at 1 o'clock a. m.; maximum of 11,916 gallons per hour on Sunday, June 30, at 10 o'clock a. m.; average of 7,160 gallons per hour.

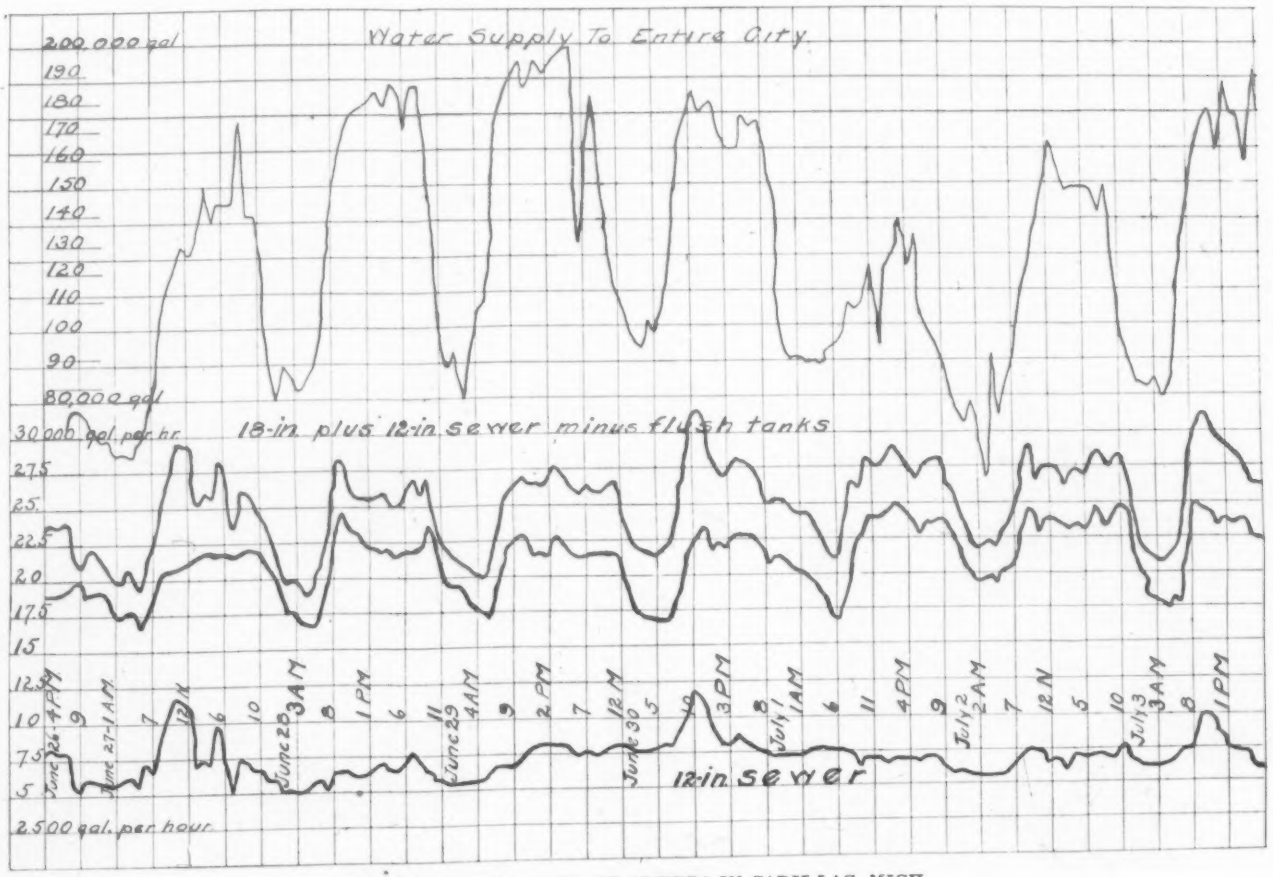
For the 18-inch outlet it shows a minimum of 16,812 gallons per hour on Thursday, June 27, at 5:20 a. m.; maximum of 25,092 gallons per hour on Monday, July 1, at 2:20 p. m.; average of 21,030 gallons per hour.

Part of the water comes from thirteen flush tanks, which are used at the heads of the sewers in various parts of the city. Three of these are on the 12-inch system and ten are on the 18-inch system. One flush tank on the 12-inch system was found to be discharging at the rate of 296 gallons per hour and another at the rate of 283 gallons per hour. On the 18-inch system one flush tank was found to be discharging at the rate of 240 gallons per hour, another at 236 gallons per hour, and a third at 189 gallons per hour. By comparing similar forms of flush tanks we estimated that 870 gallons of water per hour were discharged into the 12-inch system and 2,330 gallons per hour were discharged into the 18-inch system, or a total of 3,200 gallons per hour.

Another curve was therefore plotted on the diagram, showing the combined discharge of the 12 and 18-inch systems after subtracting the discharge of the flush tanks.

This curve shows a minimum of 18,904 gallons per hour on Friday, June 28, at 5:20 a. m.; maximum of 31,576 gallons per hour on Sunday, June 30, at 11:20 a. m.; average of 25,134 gallons per hour; total of 4,200,000 gallons for the week.

Nearly all the sewage comes from either private residences or from stores. There are no factories or other institutions using much water in their operations except one laundry and one livery barn. Neither is there sufficient leakage of ground water into the sewers to take into account. The soil in which the pipes are laid is mostly sand or gravel, which drains very readily. By comparing the curves in the diagram of the amount of water pumped and the discharge of the sewers during the rain on June 30, it will be seen that there is only a slight difference in the curves, and this is probably due to the rainwater from a few roofs which are connected



RESULTS OF GAUGING OF SEWERS IN CADILLAC, MICH.

with the sewers. The discharge can therefore be termed domestic sewage.

In order to determine the discharge per capita, the next step was to ascertain the population using the sewers. A map of the city was prepared, showing each lot connected with the sewers. This map was given to one of the substitute mail carriers of the city who was particularly well acquainted with this district. Taking this map, he went over the entire district very carefully and marked on the map opposite each lot the number of persons living on the lot. This required the exercise of more or less judgment in some cases, especially in the business district, so as to not count any person more than once.

From this map it was found that there were 475 persons using the 12-inch system and 2,517 persons using the 18-inch system.

Using these data, we find, after subtracting the flush tank discharge, that the 12-inch pipe was discharging at a minimum rate of 221 gallons per capita per 24 hours; maximum rate of 558 gallons per capita per 24 hours; average rate of 318 gallons per capita per 24 hours.

And for the 18-inch pipe we find a minimum rate of 138 gallons per capita per 24 hours; maximum rate of 239 gallons per capita per 24 hours; average rate of 178 gallons per capita per 24 hours.

For the 12-inch and 18-inch pipe combined we find, after subtracting the flush tank discharge, as above, a minimum rate of 152 gallons per capita per 24 hours; maximum rate of 253 gallons per capita per 24 hours; average rate of 202 gallons per capita per 24 hours.

During the early part of October, 1908, the septic tanks of the sewage purification works were completed and the sewage from the 18-inch pipe was turned into them. By noting the time of filling, a rough check was obtained on our former figures. Assuming that the population using the 18-inch sewers had increased from 2,517 to 2,550, the tanks showed a discharge of 240 gallons per capita per 24 hours, including flush tanks, or 214 gallons per capita per 24 hours, subtracting the flush tanks.

For purposes of comparison the superintendent of the water works took readings on his pumps during tne time we were gauging the sewers, and these records are also shown on the diagram. The record of the weather was obtained from the C., R. & I. Railway.

These gaugings seem to indicate a water waste of over 15,000 gallons per hour, or at the rate of 120 gallons per capita per 24 hours. This waste of water is ascribed by the superintendent of the water works to the use of hopper closets, in which a ½ or ¾-inch pipe is kept running continually.

REINFORCED CONCRETE RETAINING WALL AT ST. GEORGE, STATEN ISLAND.*

By Louis L. Tribus, Commissioner of Public Works, Borough of Richmond, New Brighton, N. Y.

At a recent meeting of the Municipal Engineers of the City of New York, Mr. Louis L. Tribus, the Commissioner of Public Works of the Borough of Richmond, New York City, presented a paper describing the Municipal Ferry at Staten Island, the new construction designed in connection with the ferry houses and the steam and electric terminals, and in particular the reinforced concrete retaining wall which is necessary to separate the grades of the railroad level below and the street surfaces above. From the paper descriptions of the design and construction of the retaining wall are abstracted. We are indebted to Mr. Tribus for photographs of the wall and its appurtenances under construction and practically completed.

In taking up the studies for the different retaining walls needed, which would vary in height from a minimum of 10 feet to a maximum of about 45 feet, many types were considered: Rough rubble masonry of gravity section; monolithic concrete of gravity section; combination of heavy rubble and cut stone; reinforced concrete

*From a paper before the Municipal Engineers of the City of New York.

with cut stone facings; and that which was finally selected after years of study—a so-called reinforced concrete wall, but more truly a wall made of steel rods, enclosed in concrete for protection and as slabs to retain the earth embankments. Fig. 1 shows the face of the wall as completed, a section of wall through a slab and also through one of the reinforced counterforts.

Many test pits were dug and borings made to determine the foundation conditions, as also tests of the compressibility and suitableness of the materials encountered; years of observation gave good information as to the average angle of repose of the embankments to be supported; laboratory tests were made of various types of deformed steel bars so as to select the forms that would give the closest union with concrete.

In some places pile foundations were found to be desirable, but in general a form of hard-pan or rock was reached at the depth selected for the base course. On the South and Jay street walls the determining factor was the level of the railroad yard, so that the foundation slab was put in place at the level of mean high water, which is about 5 feet below the track level at the northerly end of the railroad yard and somewhat more than that at the southerly end.

Following excavation, a 3-inch layer of concrete was placed, of the requisite width for the varying height of wall. On this the steel of the counterforts was assembled horizontally and fastened with clips, then erected and supported in position; vertical and horizontal face rods were then placed in position and fastened, after which the lower and upper courses of base rods were secured. The concrete base was then completed, acting as an anchor for the steel work, following which concrete for the counterforts and face wall was put in position simultaneously in heights of 3 feet. Fig. 2 shows the steel rods in place for reinforcement of the base of the wall and the counterforts.

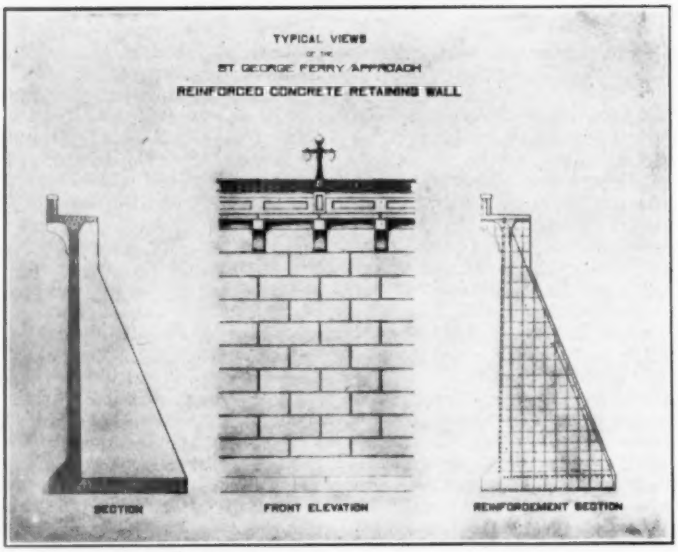
The design of the steel frame work is such as to develop almost entirely tensile rather than compression strains, and great care has been taken in the alignment of the steel skeleton. So stiff and rigid has it been made by wiring together all intersecting bars that it has been used by the contractor to carry the mold forms, which were raised section by section as the concrete set in place to form the walls.

Joint strips were fastened to the outer molds, so that the finished work simulates "ranged ashlar" in blocks 3 feet in height by 8 feet in length (Fig. 3). As soon as the concrete had thoroughly set, and immediately upon the removal of the form, the outer face was rubbed smooth with brushes and carborundum stones, together with a thin coat of pure cement grout. On final completion, the whole surface was cleaned with water and carborundum stones to remove stains, etc. The work and its effect are shown in Fig. 3, but the reproduction gives only a faint idea of the improvement in appearance.

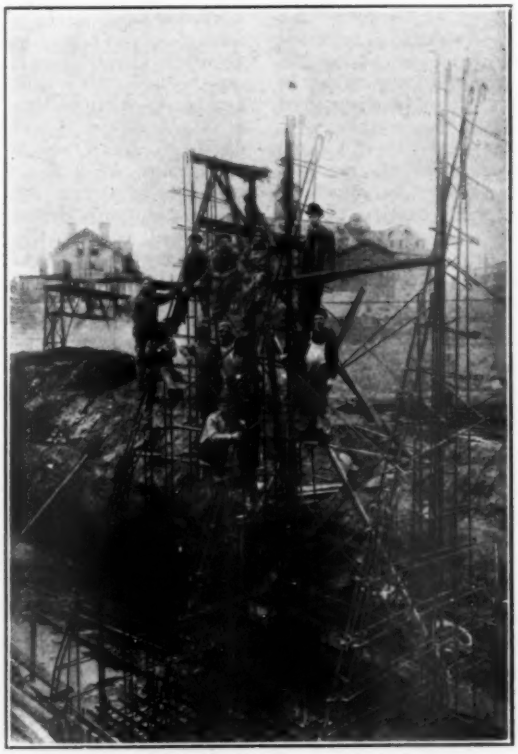
As a concession to artistic taste and perhaps conservatism, the parapet is finished with a granite facing on the street side and a granite coping. One section of the finished sidewalk is formed by a slab of reinforced concrete resting on the tops of the counterforts. The wall, as seen from the rear, is a series of vertical prism-shaped boxes which hold the earth filling, thereby not only retaining the roadway but aiding by the weight of the earth contained to hold the wall in position. The width of the base is half the height of the wall. Near the bottom of each pocket a 4-inch pipe opens through the front slab, a trifle above the ground level, so as to afford proper drainage, and, so far as possible, coarse material is used for the lower portion of the back filling. The South street walls are shown in Fig. 4, which shows parts of face and back. Fig. 5 shows the front of the Jay street wall.

In all of the work to date, very great credit is due to two sets of people: first, to the city's engineers and their assistants, who have given to the subject so much of careful and intelligent study, working out every detail in advance of construction, so that the plans upon which the contractors bid became the working plans without essential change, and it must be remembered that three years ago, when the plans were being prepared, there was but little information in this country in available shape on the design of such walls and practically no experience as to their behavior under load.

The others to whom credit is due are the contractors, engineers and assistants, who in a very intelligent way have carried out the work in a time and labor-saving manner, well shown by an inspection of their shop and yards and the classification of materials, so that at a moment's notice any particular piece of timber or steel could be found; also in the method of



I. REINFORCED CONCRETE WALL, ST. GEORGE, STATEN ISLAND.
Typical Sections and Elevation.



II. REINFORCED CONCRETE WALLS, ST. GEORGE, STATEN ISLAND.
Steel Reinforcement in Base and Counterforts.

assembling the materials, where judgment no less than skill has been required.

The following more technical description of the work may be of special interest to some, while the photographs, sketches and the foregoing general description will probably suffice for others.

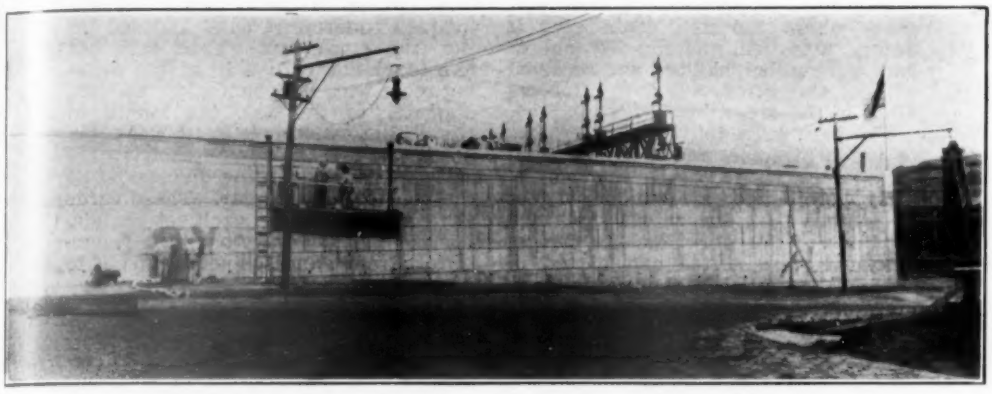
All of the wall is of the same general type, having an L-shaped cross section, with the base equal to about one-half of the height. (Fig. 1.) The vertical portion is 12 inches thick at the top with the vertical rear surface and a front surface battered 1 in 48. It is reinforced by vertical and horizontal bars, 6 to 12 inches apart on centers, close to the outer face, and by vertical counterforts 12 and 15 inches thick and 8 feet apart on centers. These are each reinforced by two complete sets of vertical and horizontal and diagonal bars, one set 3 inches each side of the center of the counterforts, as indicated in Fig. 2. The base of the wall projects uniformly 4 feet beyond its vertical face, where it is finished with a 45-degree fillet forming a massive toe intended to increase stability and reduce the stresses. (Fig. 1.) It is reinforced with upper and lower tiers of continuous horizontal longitudinal rods to which the lower ends of the vertical and inclined rods in the counterforts are hooked. The horizontal transverse rods in the counterforts are also hooked to the horizontal longitudinal rods in the main wall, and to the inclined rods in the rear edges of the counterfort, providing a very strong bond almost equivalent to trussing, in the reinforcement.

In some cases the upper part of the wall terminates in a simple parapet and in other cases it supports a double-cantilever reinforced concrete sidewalk, forming a T-shaped cross section. The sidewalk concrete is 6 inches in minimum thickness, with an upper surface sloped 1 to 36, and finished with 1 inch of granolithic. It is strengthened by curved and straight fillets, forming continuous corbels on the inner and outer faces of the wall, and by curved knee-braces or brackets 4 feet 2 inches deep and 18 inches wide at counterfort points on the outer face of the wall. (Fig. 1.) The brackets are lightly reinforced and are integral with the top of the wall, the sidewalk and the parapet, thus making a monolithic structure of great strength. The inner face of the parapet is veneered with a vertical slab of cut granite 6 inches thick and dressed to careful bearing at the upper edge with the granite coping.

Where no sidewalk is provided on top of the retaining wall the construction of the coping and the granite face to the inside of the parapet are the same as above described, but the thickness of the top of the wall is increased 4 inches on the inner face, to form a beveled shoulder just below the surface of the street, and provide bearing for the upper end of the counterfort, which tapers to a point. Cut granite pedestals 18 inches square and 3 feet 3 inches in height are located about 120 feet apart in the parapet wall to form supports for ornamental lamp posts. They are provided with a 3-inch vertical hole in the center, through which is run a curved 1-inch galvanized iron conduit pipe, capped and screwed at both ends, and having the horizontal portion embedded in the concrete of the bracket and counterfort to provide for the future installation of electric light wires.

All concrete, except for extra foundations, is made 1:2:5 with sand or 1:4:5 with screenings in place of sand, and for large work is mixed with 1½-inch stone. For small work, moldings and other special places, the 1½-inch stone is replaced by ¾-inch unscreened stone, and all mortar faces are made with cement and screenings of stone from ¼-inch maximum size down to dust, free from dirt, in the proportion of 1:3. For all exposed surfaces of coves, brackets, moldings, etc., mortar not less than ¾ inch thick is placed against the forms with the 6-inch layers of concrete backing and thoroughly puddled. No mortar facing is required for the main wall, but the concrete there is carefully spaded against the face of the form and within an hour after the removal of the latter it is ground to a smooth surface and where necessary washed with pure cement. Special pains are taken to secure high-grade steel in the reinforcement bars, which are required to have an elastic limit of 40,000 pounds, and an ultimate strength of 75,000 pounds per square inch, to elongate not less than 20 per cent in 8 inches and to endure cold-bending tests. The principal quantities involved in this contract are 9,400 cubic yards of concrete, 1,147,000 pounds of reinforcement steel, 23,000 cubic yards of excavation and 40,000 lineal feet of foundation piles.

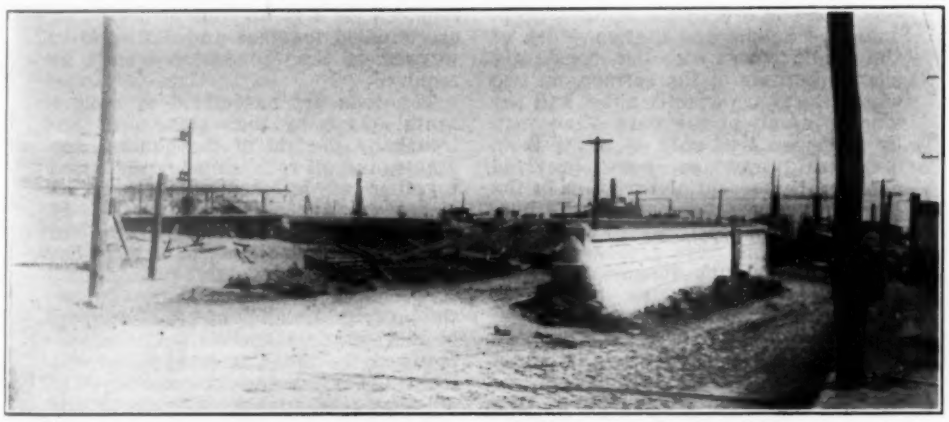
Owing to the large amount of steel in the retaining wall, the great length of some of the bars, the requirements that the pieces should be single-length



III. REINFORCED CONCRETE WALLS, ST. GEORGE, STATEN ISLAND.
Rubbing Down. Note Effect at Left End.

unspliced rods and the necessity of maintaining them in exact alignment and position, the problem of construction became a difficult one, and was considered to involve heavy erection expenses. The contractors believed its satisfactory solution to be the key of the success of the whole work and devoted very careful attention to it as a primary feature, about which other requirements and conditions could be arranged with more or less modification to suit the best method of handling the steel. It was evident that the great weight, length and number of bars and their somewhat complicated arrangement would involve costly and elaborate molds, falsework and bracing if the usual custom of spacing and supporting the steel from the molds was followed. It was therefore decided to make the steel independent and self-supporting and to impose no other duty on the molds than that of retaining the wet concrete around the steel bars.

The type of bar manufactured by the Expanded Metal and Corrugated Bar Company was selected and approved, and preparations were made for ordering the 50,000 pieces required, of exact mill length, thus avoiding waste and cutting at the site. It soon appeared, however, that no economy would be derived by this plan on account of the probability of mistake and the great labor in sorting and maintaining the different lengths, varying only by ½ to ¼ inch. The bill of material was therefore made with all the bars grouped under order lengths varying by 3 inches from a minimum of about 3 feet to a maximum of over 50 feet. Fortunately



IV. REINFORCED CONCRETE WALLS, ST. GEORGE, STATEN ISLAND.
South Street Walls, East Side Finished.

this order was made at a time and place where the mill could give it prompt attention, and the 600 tons of bars were rolled, shipped and received without about forty-five days after the filing of the order.

The bars were delivered by lighters to the contractor, and were received in great confusion of size and length. They were carried a few hundred feet by wagons to a convenient stockyard adjacent to the work, and as fast as unloaded were sorted and placed in bins for each length, plainly marked on a board at the end of every bin. This work cost about $1 per ton, but having been done once for all, greatly facilitated the ease and rapidity of future operations, and has proved a very profitable investment.

The steel reinforcement bars are broadly divided into two classes, those in the vertical planes of the counterforts and those in horizontal planes perpendicular to them. Supporting and securing the latter offered no difficulties, as they are readily located and fixed in the required position on the counterfort frame. The treatment of the counterfort bar was the difficult problem, which was simply and successfully met by the contractor's engineer, who determined to assemble and rigidly connect all of the bars for the counterforts in complete frameworks and erect them before the construction of the concrete forms, thus allowing the latter to be made with the simplest form of short sliding panels. The work has been carefully systematized, and the greatest economy of transportation, assembling and erection has been secured by cutting, bending, marking and bundling the bars at the storage yard, transporting each counterfort set as a unit and assembling and erecting it in the trench.

As the height and bottom width of the walls vary with a constantly changing grade of the surface, no two counterforts are exactly alike, and the lengths of all of the bars often vary by increments of only ½ or ¼ inch.

General drawings were provided showing the essential variation in the number and arrangement of the bars in the counterfort frames, and special small diagrams were prepared giving exact lengths and dimensions of all bent bars and showing the hooks which are required at the ends of nearly all of the bars of each counterfort. Tag cards with wire fastenings were printed for every bar in the structure. These cards are of four distinct colors, white for the horizontal counterfort bars, green for the vertical counterfort bars, yellow for the inclined counterfort bars, and red for the transverse bars. Each card has five blank lines filled in at the drawing room with the counterfort number, diameter of the bar, the length of stock from which it is to be made, the designation of the sketch showing the type, and the governing dimensions of the bent or finished bar. These cards are made up in sets, each set containing one card for every bar in the counterfort frame, and the sets are sent to the superintendent of the bending shop, who makes two series of bars for each set, corresponding to the two planes of reinforcement in each counterfort.

The cards are first delivered to the stockman, who selects each bar as required from the bin and attaches the card to it and delivers it to the bending shop. At the bending shop the bars are cut to exact length and placed on a table in sets of fifteen or twenty, with one end inserted in a coke furnace, where it is heated cherry red, withdrawn, moved a few feet transversely, placed on the bending table and the hook or intermediate bend quickly turned to exact dimensions. The bar is then moved transversely across the shop and the other end inserted in a second heating furnace, from which it is withdrawn and placed on a second bending table provided with a horizontal graduated scale 50 feet long. A movable stop is set at the required point on this scale and the bent end of the rod placed against it so that the heated end is in precisely the required relative position for the second bend to be accurately made by the fixed bending mechanism. The finished bars are taken from the table and all of those required for a given counterfort frame are bundled together and delivered in wagons to the foundation trench as required.

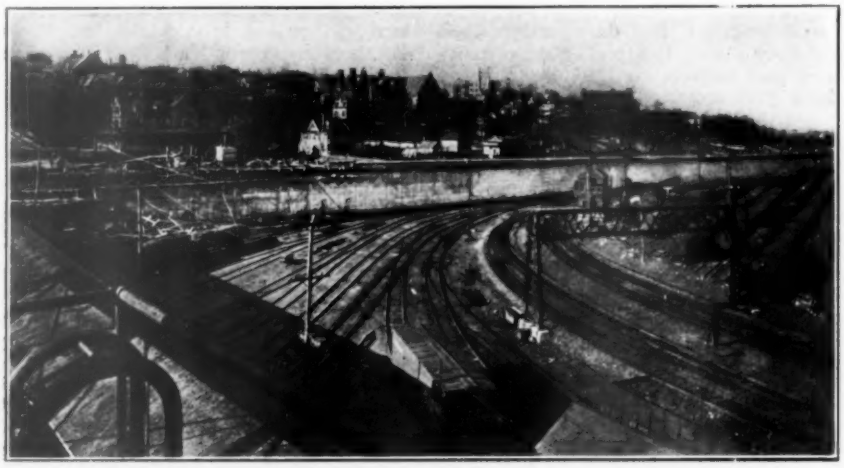
The rods are assembled in a horizontal plane in the bottom of the trench by the aid of the general diagrams, and all rods are securely wired together at intersection with short pieces of very soft annealed No. 16 gauge wire, which is twisted tight and grips the corrugations so firmly that the two frames or sets of rods in each counterfort are always maintained at the uniform distance of 9 inches apart in the clear. A special device manufactured by the Universal Reinforcement System Company was provided for separating and securing them, and has proved very successful. It consists of a short strip of 1 by ⅛-inch

flat steel, notched on opposite edges to receive staples of short, bent wire that are tightly secured by closing the notches with a single blow of the hammer.

Two duplicate frames for a counterfort having been assembled, one of them is blocked up 9 inches above the other in a horizontal plane, and the spacing pieces are inserted and the projecting wires twisted around the bars with which they are in contact, thus holding them very firmly and securely. The system of rods thus assembled forms a skeleton with abundant strength for its erection and maintenance, and it is easily revolved from a horizontal to a vertical position by means of a light tackle from the top of the last erected piece, or may be bodily set in position by a derrick when one is conveniently located for this purpose.

After the double frame is approximately located transversely, longitudinally and vertically, it is securely braced in position by some of the shorter pieces of reinforcement rods temporarily lashed to it in a horizontal longitudinal position, and others serving as longitudinal X-braces, which give it complete stability and virtually constitute a system of trussing which distributes stresses throughout the structure and keeps all portions of it in the required position. Final adjustment is secured by reference to the engineer's marks given on both sides of the trench and by measurement from horizontal arms projecting from the upper ends of vertical poles very accurately set in the line of the wall about 50 feet apart. Both heights and alignments are determined by the position of the top and bottom longitudinal horizontal bars wired to the counterfort bars so accurately that none of the steel can become displaced more than ¼ inch, and so strongly that it has an independent stability regardless of the forms and sufficient to enable it to dispense with all external bracing and guys, and even to sustain working scaffolds and concrete platforms, which are extremely convenient and useful in the construction of the wall.

Considerable quantities of Giant Portland cement were stored in the office and warehouse building rented by the contractor, and sand and broken stone were kept in large piles on the surface of the ground. The various materials were delivered in wheelbarrows to Smith mixing machines of 1 yard capacity. One of these machines was located near the dock, on a low tower with an inclined wheelbarrow approach, and delivered through a small loading hopper provided with a segmental cutoff gate, operated by a lever, through which Ransome dump carts were filled. The carts were pushed by hand along a wheeling platform between the two parallel walls and diverted at different points on short transverse extensions to the face of the wall between counterforts. To reach the top of the wall, these transverse platforms were



V. REINFORCED CONCRETE WALLS, ST. GEORGE, STATEN ISLAND.
Jay Street Wall as Seen from Ferry House.

somewhat steeply inclined in places and tackles were provided for pulling the carts up grade. For the other section of the wall, at the north end of the location, the mixing machine was located on top of the bank above the top of the wall and just below the surface of the road, and delivered through a cut-off valve to a steeply inclined chute, discharging into wheelbarrows on a runway alongside the wall.

Although the rear faces of the counterforts are inclined, their molds were made full length for about one-half the height of the wall, where they were reduced and built up to the top with a second continuous length, the sloping rear surface being secured by placing an inclined edgepiece between the vertical faces and nailing it securely in position. As fast as each successive vertical section of the wall was completed and set, the mold bolts were withdrawn and the molds moved upward one course, so that their lower edges just engaged the finished concrete and were kept in place by bolts and spacing blocks in the upper part and by the extension of the vertical cleats below the lower edges of the side boards.

The upper edges of the mold for the counterfort served admirably to support working platforms, and the whole system was very rapid, convenient and economical. Special molds were of course requisite for the cantilever sidewalk and fillets, and some difficulty has been experienced in satisfactorily securing them on account of their inclined position and the absence of vertical supports. This has, however, been successfully met by wiring them to the reinforcement bars, which are rigid enough to make this practicable. The curved surfaces of the cornice and brackets finishing the top of the wall on the exterior face were covered by the use of special galvanized iron molds in 7-foot sections to correspond with the spacing of the counterforts.

A COMPARISON OF BRIDGE WATERWAYS.*

By Daniel B. Luten, President National Bridge Co., Indianapolis, Ind.

IN a recent design for a concrete bridge of several spans, the suggestion was made to the engineer in charge of the design that a camber of two or three feet which would elevate the roadway and crown of the main span slightly would enhance the appearance of the structure. The engineer who was one of the old-fashioned over-practical kind, replied that he had never observed the water in that particular river to have such a camber, and he could therefore see no reason for it in the bridge. He required therefore that the roadway should be level throughout its entire length on the bridge, while the approaches fell abruptly to a much lower level. This engineer was mistaken in his first assumption, for the surface of a river is curved, although in falling floods it may be concave upwards, the reverse of what is desirable for a graceful camber in a bridge.

But his attitude is typical in many ways, of the preference that many engineers have for a straight-girder bridge, and who give as a reason for their preference the argument that the girder bridge has a great advantage in waterway over other forms. Similarly in the erection of arch bridges, it is quite the usual thing to find an engineer insisting on arches with high springings, in order to increase the waterway. It is believed that a comparison of waterways will show the above ideas to be fallacious, more especially for concrete bridges.

Let us, for convenience in comparison, assume that all waterways are divided into the three classes shown by Figs. 1, 2 and 3, the rectangular form in Fig. 1 representing the usual opening for girder bridges; the V form of Fig. 2 representing the general type of opening converging at the bottom of which a usual form is the egg-shaped sewer; and the A form of Fig. 3, representing the type converging at the top, of which the arch is the most usual form. Let us assume, also for the purpose of comparison, that the areas of the three waterways are equal.

In attempting to determine which of these three forms is the most efficient, three principal features may be compared; the efficiency of the structure required to span the opening; capacity

*A paper before the Indiana Engineering Society.

for discharge of water; and capacity for discharging ice and floating debris.

It is apparent at a glance that the structure required to span the V form of opening of Fig. 2 will be less efficient than that required to span the same area of waterway in Fig. 1, having the rectangular opening, for the span is greater. The A form of Fig. 3 also requires a longer span than Fig. 1, but in this case the disadvantage of longer span is offset by the greater efficiency of the type of structure that may be used to span the opening. It will be noted at a glance and without any mathematical analysis, that the structure spanning Fig. 3 is of a stronger type than that spanning Fig. 1. An opening of the A type in Fig. 3 even proves self-supporting at times in stiff clay soil, witout any supporting structure, whereas the girder type of Fig. 1 would never do so. In reinforced concrete especially the arch has a decided advantage over the girder in that a much greater percentage of its material may be subjected to comparatively uniform and high unit stresses. A steel beam or girder is a comparatively efficient structure, having upwards of 50 per cent. of its material effectively under stress and doing work. And the steel girder has advantages in fabrication and erection that cannot be approached by the steel arch except for the longest spans. But in reinforced concrete an entirely different relation exists. Concrete is effective in compression only, so that all concrete below the neutral axis is waste material in so far as sustaining stress and doing work in supporting loads is concerned. Above the neutral axis the stress ranges from zero to the maximum allowable stress, so that but one-half of that half of the girder is employed at its greatest possible efficiency. And these conditions again range from maximum stresses at the middle of the span to a minimum near the supports. It is safe to say, then, that upwards of three-quarters of the concrete in a girder is useless in supporting loads and therefore does no work except to protect the embedded steel, and that, if the concrete could be placed as to subject all of it to its maximum allowable stress, less than one-fourth of the concrete required in a rectangular girder under present con-

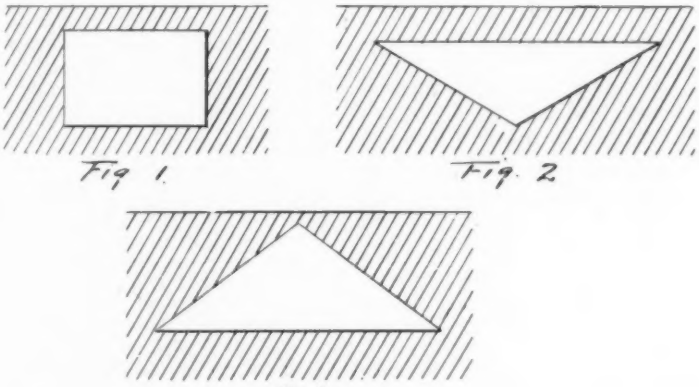


Fig. 3.

PLATE I. TYPICAL FORMS OF WATERWAYS.

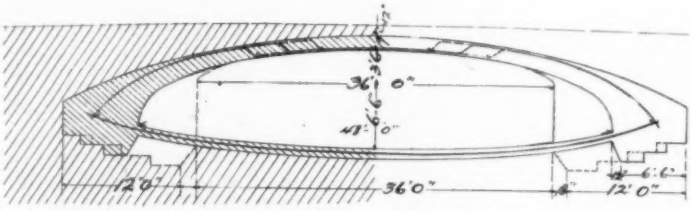


Fig. 4.

PLATE II. TWO FORMS OF ARCHED WATERWAYS.

ditions would be sufficient to sustain all stresses.

In the concrete arch quite a different condition exists. The region of compression, which in the beam was limited to the upper half only, is extended in the arch by reason of the thrust, so that the entire area of the arch ring may be in compression, and in certain parts in uniform compression, which, of course, is the ideal condition from the standpoint of efficiency. If the arch curve be chosen to be in equilibrium under the fixed load alone, and no moving loads applied, the entire arch ring would be in uniform compression and with no waste material whatever, a condition that has no parallel in the case of a beam, whether of concrete or steel. While tension may occur in the arch due to moving loads, the regions of tension are much more limited than in the girder, and the degree of tension much more restricted. In consequence a much larger percentage of the concrete employed in the arch is useful in resisting stress and in supporting loads.

The arch, moreover, is in the very nature of its form the more efficient structure of the two, for it takes advantage of the passive resistance of the embankments and abutments against lateral displacement, while the girder bridge must actually overcome the active pressure of the embankment to no useful purpose. The difference in efficiency of these two types of structures is well illustrated in their application to long spans. No designer would employ a concrete girder for spans of 150 feet, although such a design would be quite feasible except for economic considerations. But arch spans of 150 feet are not at all unusual. Where then is the modifying condition that causes the girder to become more efficient than the arch for short spans, when it assuredly is not for long spans? Apparently the condition that can produce such a result must be sought, not in their relations as to amounts of material required, but rather in the cost of forms and placing of materials. And as these two items do not often exceed 10 per cent. of the cost for each, there is not a great opportunity for a showing of efficiency in these two factors, and only for the shortest spans, say up to 10 or 20 feet, is this saving sufficient to offset the decreased material required for the arch.

It is not unusual to see on some of our railroads twin-span box culverts under heavy fills, the designer actually blocking the waterway with a pier in order to support his ineffective slab under such conditions. A further error of judgment is frequently made in such cases by the designer, who computes the beam on the assumption that part of the earth loading is self-supporting, due to arching of earth fill, whereas there can be but little doubt that the entire fill of earth vertically above the beam rests its weight upon the slab. The arch of single span, instead of the twin-span beam culvert, is the logical structure under such conditions, and for quite as simple reasons as that a square peg will not fit a round hole.

In comparing the openings for efficiency of discharge of water, the V form of Fig. 2 is, of course, to be preferred for continuous water courses, such as sewers or conduits, because its hydraulic radius is a minimum for shallow flow, thus insuring maximum velocity and discharge. But when such an opening constricts a watercourse, as is usually the case in bridge openings, quite a different condition exists; the opening should be designed to avoid obstructing the stream and to prevent damming up of the current, especially in times of flood; it might be assumed off-hand that the V-shaped opening would be favorable for flood discharge, because as the water rises the span becomes greater. But in reality this V-form of opening must first retard the flow of water and force it to a flood level before it provides for a flood discharge. It is the one form of opening that certainly does obstruct the channel in floods. Where the general bed of the stream is broader and flatter than the opening itself, as would almost invariably be the case in bridges, such an opening as the V form cannot provide flood discharge without damming the current, the very feature that we desire most to avoid.

For quite similar reasons the A form is more effective than the rectangle. Considering discharge of water alone, the A form is without question the most effective of the three, since its center of pressure is lowest, and it consequently discharges under greatest head for any given level. Assume for example that an outlet be cut through a dam to release the contained water; the A form of opening will, of course, release the water most rapidly, and the higher the water level the more marked will be its advantage. Acting in exactly the same way in floods, this form would provide maximum flood capacity as a bridge open-

PLATE III. ARCH OF 36-FOOT SPAN WITH ELEVATED SPRINGINGS.

ing. The fact that the stream may flow full below the bridge as well as above, has no bearing, for this will be true only so long as the bridge opening does not obstruct the stream. The moment that the waterway becomes an obstruction, a head is formed, and the case becomes parallel to that of the dam cited above.

The V form of Fig. 2 and the rectangular opening of Fig. 1 have therefore no advantage for flood discharge only, and the A form of Fig. 3 or the similar arch forms will discharge the greatest volume of water for the same area of waterway.

The question of behavior of ice and debris in floods is an extremely difficult one to deal with because it assumes such varied forms that it is almost impossible to reduce it to any law. Debris and ice run with the current on a rising flood, but lodge at the sides as the flood falls. The V form of opening might seem to have an advantage in that it clears itself of debris in a rising flood, but with a receding flood the debris lodges and clings to the sides of the opening, leaving it at all times littered and obstructed until the next flood carries it away and leaves a new deposit.

The rectangular opening of Fig. 1 has an advantage in that rise or fall of water level does not result in lodgment of debris. This form is obstructed by floating logs so large as to span the entire opening and lodge against both abutments, by trees with tops too large to pass under the span, and by drift against the abutments, stranded by falling flood level. The arch form will be obstructed by these same conditions, but with this advantage that a fall in the flood level will tend to dislodge drift rather than to permit it to lodge, as in the V form of opening. And there is not a corresponding tendency in the arch for floating debris to lodge against the arch with rising flood as might be anticipated, because the suction of the current deflected downwards into the opening tends constantly to force it down and through the opening. Any tendency of the drift to pile up against the structure produces the same result, for its increasing weight crowds it downwards to a point where the increase in span permits it to escape. An arch opening may even be completely submerged without danger of obstruction; debris may remain floating above the opening and be unable to find an escape as long as the flood rises, but will do no harm unless it becomes so excessive as to cause a jam. It is rare indeed, however, that the water is backed up by an opening except in small culverts, provided the crown of the arch is above normal high water, for a backing up of the flood one or two inches on the upstream side of the arch results in a head that increases the velocity and consequent discharge by 10 or 20 per cent. A jam against an arch usually breaks as the water falls and passes away with the receding flood. The tendency for drift to lodge in the corners at the springing is easily counteracted by using an oval curve of the five-centered or seven-centered type.

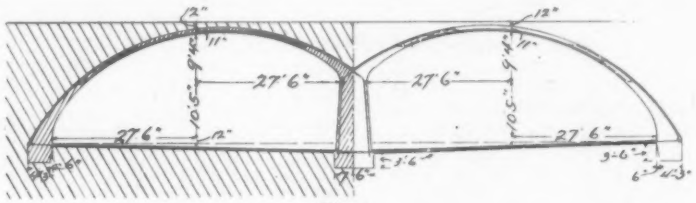


Fig. 5.

PLATE IV. TWO ARCH SPANS WITH ELEVATED SPRINGING LINE ON PIER.

Fields of ice are most readily broken up by being forced by the current upon inclined ice-breakers, causing them to slide upwards on the breaker and break of their own weight and the pressure of the current. The rectangular opening has no advantage in handling ice and must receive its impact with full force. The arch is better adapted to discharging ice than the rectangular waterway, since the downward tendency of the current at the opening tends to exaggerate the effect of the ice-breakers in breaking up a field of ice moving with the current. A more important advantage, and one that the arch bridge has over every other form of bridge, is the greater weight of the arch structure, enabling it to better resist jams of ice and debris, once they have actually formed.

It should be obvious, therefore, that

PLATE V. TWO 55-FOOT SPAN ARCHES, VERMILLION COUNTY, INDIANA.

unless a material increase in waterway results, there is no advantage in elevating the springings of an arch. And if all that is desired is increased waterway, this is much better secured in other ways in a single span arch structure. Thus, in Fig. 4 are shown in dotted outline the abutments for a 36-foot span with high springings, and in the same figure in full lines is shown a 48-foot span with low springings, the arch rings being coincident. The waterway of the 48-foot span is, of course, greater than that of the 36-foot span, yet the material required for the structure is less by the amount saved in the abutments. Here then is an increase of waterway with decrease of material and decreased cost. And the waterway of the longer span is not only increased, but is arranged in a better form to provide efficient discharge. It is rarely if ever economical in a single span arch to increase waterway by raising springings; increasing the span is much the more economical method. This is due, of course, to the fact that the thrust of the arch requires a considerable mass of material very nearly in the line of the arch, to resist its thrust, necessitating an extended abutment in connection with the elevated springings.

When arches are used in series, however, of two or more spans, the above argument applies only to the abutments and not to the piers. For at the piers the thrust of each arch is balanced against that of its neighbor and the springings may be elevated and the waterway increased without any additional material. An efficient design for such a bridge therefore will have elevated springings at the piers, and low springings at the abutments, approximately at the mean low water level.

In Plate V is shown a section of an arch bridge consisting of two 55 foot spans with the springings at the pier elevated 10 feet 5 inches above the springings at the abutments.

A similar bridge consisting of two 90 foot spans with springings at the piers elevated 13 feet above those at the abutments is shown in Plate VI. Both of these bridges were erected in Vermillion county, Indiana, the past year. In both structures a maximum of waterway is obtained with minimum materials, resulting in a bridge of great waterway capacity at low cost. waterway capacity at low cost.

The Wayne street bridge across the Wabash river at Peru, Ind., Plate VII, consists of seven spans of 75 to 100 feet each. In January, 1907, a flood raised the Wabash River to within eight inches of former high water records, and within a few feet of the crowns of the arches. Although the springings of the arches were submerged to depth of several feet in the stream, no damage resulted and no damming up of the current could be detected. It is essential of course that where the waterway is constructed by bridge opening, efficient means should be taken to prevent the increased velocity of the current from scouring the foundations. In the Wayne street bridge the piers rest on rock from six to sixteen feet below low water.

CONCRETE CONSTRUCTION IN WATERWORKS.*

By William Curtis Mabee, Engineer Indianapolis Water Co.

THE use of concrete as a building material for water works is not exactly a new departure, yet there has been such rapid progress made in the development of its application to that branch of engineering that the writer believes a brief review of some examples of recent construction will prove of interest to many who have the same or similar problems to solve.

Concrete is sometimes, though not always, the cheapest material to employ, but it has the advantage of greater permanence over wood and steel construction, and is fireproof. Concrete is peculiarly adapted for foundation and underground work, for reservoirs, both covered and open, for filtration plants, both mechanical and slow-sand, for water tanks and for chemical tanks, for water-towers and for standpipes, for water conduits and for water pipes under moderate pressure; in fact, it can be used for a great many purposes in the construction of a water purification works, and indeed it would be hard in this day to conceive a water purification works without concrete construction.

Like other building materials, con-

*From a paper before the Indiana Sanitary and Water Supply Association.

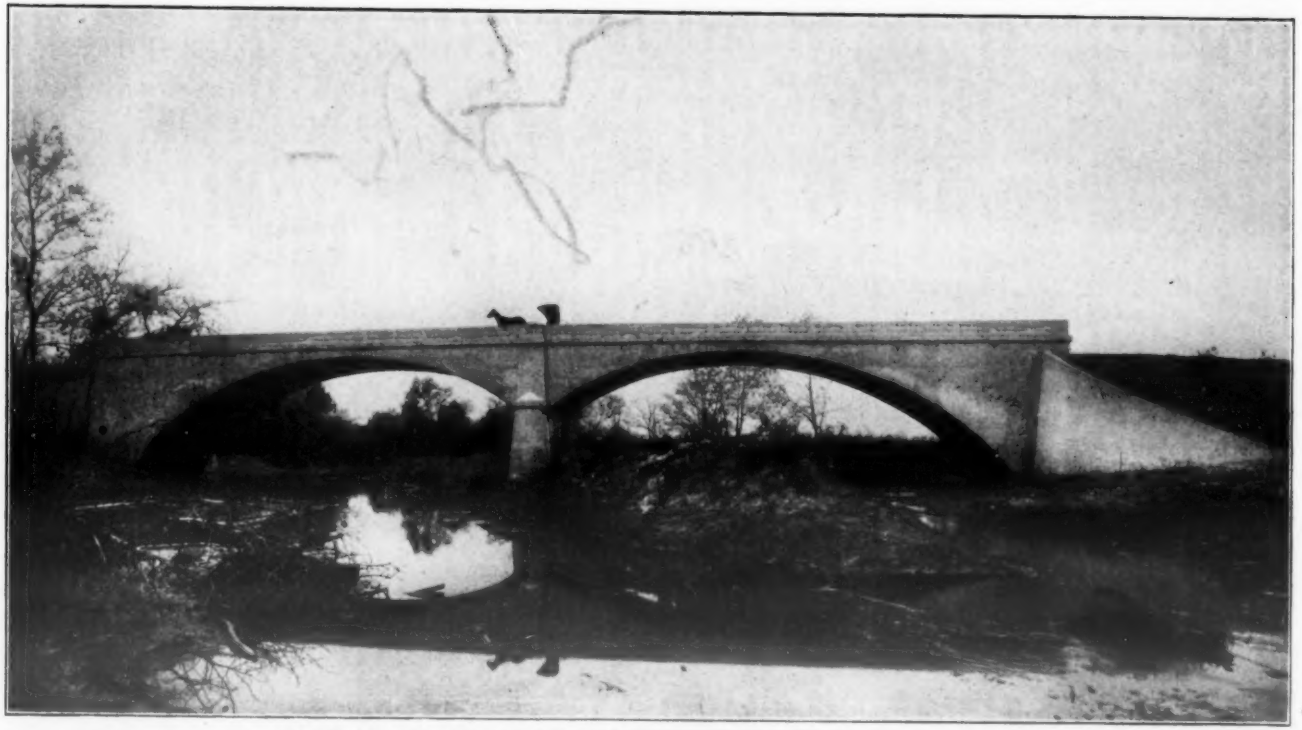


PLATE VI. TWO 90-FOOT SPAN ARCHES, VERMILLION COUNTY, INDIANA.

crete has its peculiarities. Contraction cracks are very common, yet the same cracks will be found in brick walls, and concrete is no more liable to temperature contraction than brick or stone. In concrete walls these cracks will always occur at the joining of one day's work with the next, and no amount of washing or brushing or cleaning will prevent them, and generally the wall will crack between these points. It is the common practice now to provide expansion joints at regular intervals, so that the cracks will be confined to designated points. With reinforced concrete it is not always necessary to provide expansion joints, as by a judicious use of steel bars these cracks, in objectionable form, can be prevented.

Like any good work, it requires skill and constant supervision to produce concrete. Almost any laborer who has seen concrete mixed several times, believes he is an expert concrete worker, and the work turned out by such individuals is often not worthy of the name of concrete, and many times even the foreman is ignorant of its first principles. The uncertainty of obtaining well-made concrete has undoubtedly deterred many architects from specifying this material in their buildings. A certain architect of this city told the writer of an incident that occurred not long ago on his work. He came upon his job for the purpose of inspecting the concrete work, and after watching the mixer operate for some few minutes he observed that no cement was going in or coming out. This seemed rather unusual, so he took the foreman to task about it. The foreman apologized for the omission and explained that they had just run out of cement, but expected a load very shortly.

Again, in reinforced concrete work, an ignorant foreman may place the metal where it is not needed, and omit to place it where it will do the most good. Intelligent supervision is necessary on any concrete work.

The engineer to whom is intrusted the designs should classify his concrete so that no material may be wasted. A 1:2:4 mix is extravagant when a 1:3:6 mix will do just as well. With the proper discrimination in this respect, the engineer can make a material saving in cost in works of any magnitude, and at the same time not impair the integrity of his structures.

Engineers differ regarding the proper amount of water to be mixed with their concrete, yet the writer believes that while very wet concrete is desirable under most conditions, it is nevertheless necessary to know when not to use very wet concrete. On beams and slab work, the tendency would be for the cement to separate from the sand and gravel, filling the columns and beams with a rich mixture and leaving the slab and tops of beams rather lean. It is needless to say this causes rough and unreliable work. Often over concrete columns there will be a network of reinforcing bars, and if great care is not taken these will hold back the coarse gravel in placing the concrete, thus causing an arch under which there may be no support.

Of course, monolithic construction, or the continuous placing of concrete without interruption, is to be preferred, but it is seldom possible to organize your working force in that way, and is really not essential if the various sections are bonded well with reinforcing bars and the old surface thoroughly cleaned and brushed with cement grout before beginning the day's work. The writer has seen perfectly water-tight slab work 3 inches thick made in this way.

Within the last few years concrete has come into general use as a building material for water works and water purification plants, and is rapidly replacing stone and brick masonry as a building material. The manufacturer of Portland cement has multiplied his production many times during the last ten years, and the future holds very bright prospects for him. New fields for concrete products are being constantly developed.

At one time conservative engineers were somewhat distrustful of concrete for anything but foundation work, and there still exists some little prejudice against concrete. It remained for the more bold and progressive engineers to demonstrate the usefulness and fitness of concrete for important engineering structures. By way of illustration, the writer has in mind a certain large and important dam, designed to conserve the water supply for a growing city. The original design, made by an eminent Western engineer, provided for an all-concrete structure. Before proceeding with so large and important an undertaking, the city officials thought it best to refer the matter to a celebrated Eastern engineer for his approval. This engineer was not fully convinced that concrete could be depended upon to withstand the elements, and he was not willing to take any chances; he, accordingly, advised that the core of

PLATE VII. WAYNE STREET BRIDGE ACROSS WABASH RIVER, PERU, INDIANA.

the dam might be built of concrete, but for wearing qualities he knew that nothing was better than New England granite, and therefore advised that the dam be faced with granite. The additional cost of the granite facing would have been almost prohibitive, and as unnecessary as it was expensive.

There is little doubt today of the wearing qualities of concrete if properly mixed with the right sort of ingredients and properly placed in the molds. Its ability to withstand the wear and tear of the elements has been demonstrated, leaving no doubt in the mind of the most conservative engineer.

Following rapidly on the heels of plain concrete came the ever increasing use of reinforced concrete. So today we find even dams built of this material, a radical departure from the custom of centuries, a mere shell as compared to the massive gravity dam.

Retaining walls for reservoir embankments were usually built of massive rubble or cut stone masonry. Now it is no uncommon thing to see thin, skeleton-like structures of reinforced concrete retaining immense banks of earth. No better illustration of the adaption of reinforced concrete to this class of work occurs to the writer than the new open reservoir at the Chain of Rocks pumping station at St. Louis.

In the journal of the New England Water Works Association for March, 1905, can be found a description of a concrete-steel water tower and standpipe at Fort Revere, Hull, Mass. To quote from Mr. Doton's paper: "The authorization for the building of a structure so radically at variance with the best engineering practice at that time, by a department of the Government known to be conservative in its methods, could only be accounted for by the fact that it desired by means of experiment to find a material more durable and economical in maintenance than steel for standpipe construction. Therefore the conclusion was reached that if concrete standpipes could be constructed which would be satisfactory, the solution of the problem was found. The most unique feature of the entire structure, and unprecedented in the nature of its construction in this country, is the concrete standpipe. It is 20 feet in internal diameter and 50 feet in height. The walls are formed of a thin shell of concrete 6¼ inches in thickness at the base and 3¼ inches at the top, in which is imbedded a complex system of steel rods."

In conclusion Mr. Doton says: "The erection of this standpipe has been a successful experiment and has demonstrated the adaptability of concrete as a material for structures of this class, when it is properly handled."

The paper contained some descriptions of recent structures in concrete built for the Indianapolis Water Company, which will appear later.

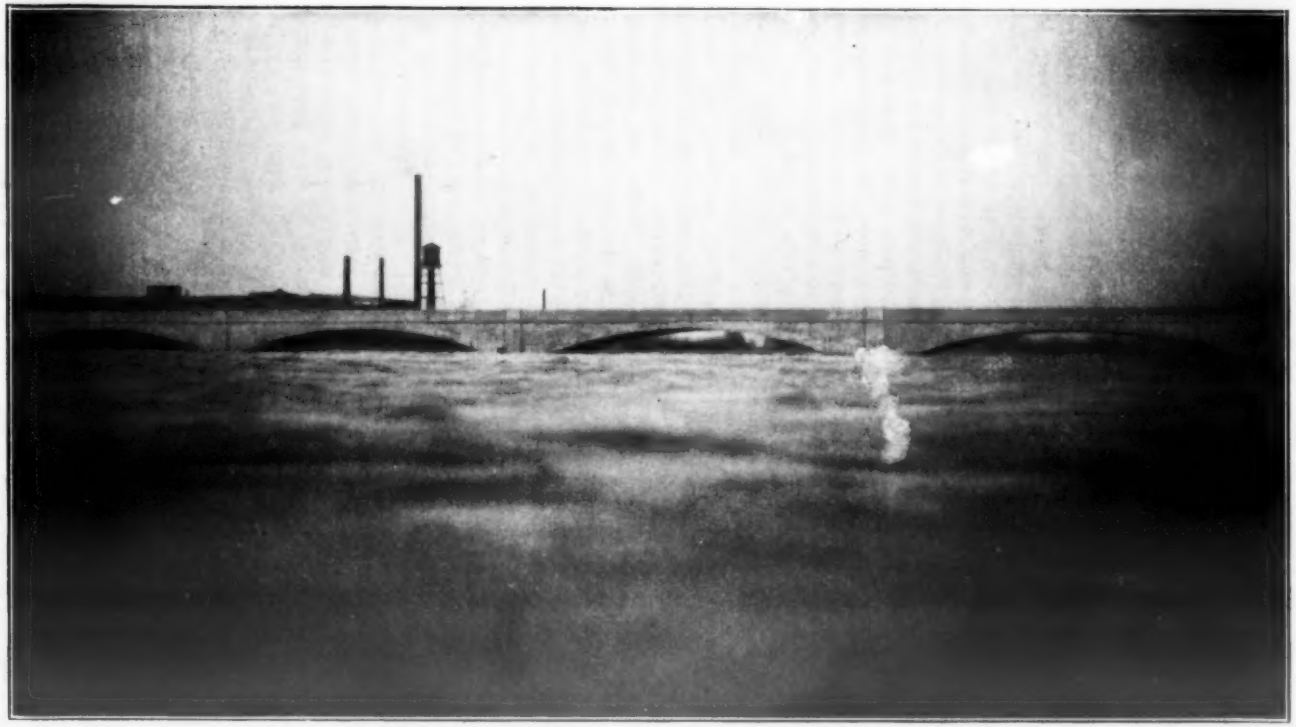


PLATE VIII. WAYNE STREET BRIDGE, PERU, INDIANA.
In Wabash River Flood of January, 1907.

EDITORIAL COMMENT

The Gatun Dam.

Technical Society Papers.

Municipal Asphalt Plants.

The New York Gas Rate Law.

THE GATUN DAM.

The sensation mongers of the daily press, probably incited by interests inimical to the Panama Canal have made numerous attacks recently upon the sufficiency of the plans for the Gatun dam, and have denied the possibility of building the dam upon the foundation available.

Mr. C. M. Saville, whom our readers will recognize as the author of a series of articles upon the Metropolitan Water Supply of Massachusetts, which appeared in MUNICIPAL ENGINEERING, volumes xxxii and xxxiii, has been in charge of the force investigating material and methods of handling them on the canal. He spent about a year upon the Gatun dam, determining the character of the foundation rock, the deposits thereon and their position and condition, and experimenting upon the best methods of building the dam and of making both dam and substrata impervious to the 85 feet head of water to which such portions of it as are at or below sea level may be subjected. He is well fitted by training and experience for this work, having been closely connected with similar work upon the very extensive works in and about the Wachusett reservoir of the Metropolitan Water Supply Commission, which are in some respects equal in difficulty to those on the Panama Canal.

Mr. Saville's report on his investigations was made to the canal commission some months ago and has recently been published as Appendix E of their report.

In brief, the conclusions drawn from his investigations and experiments regarding the foundation of the dam and the possibility of making it impervious are as follows:

(1) The rocks themselves, even those portions which are soft and readily yield to excavation methods, are of sufficient strength to support any loads that may come on them in the proposed construction.

(2) Some of the rocks are of open texture, and permit the flow of water, the readiness with which this flow is allowed depending mostly on the condition of the rock and its resistance to the disintegrating action of surface conditions.

The principal water-bearing medium seems to be the joints and seams which cut through the various strata and allow the passage of large quantities of water. The occurrence of water-bearing joint planes in great part, and to a lesser degree the presence of a layer of disintegrated conglomerate of coarse sandstone at the southerly entrance of the spillway, will undoubtedly require the construction of a masonry cut-off wall in the hill at this point. This work, however, presents no serious difficulty and only such engineering construction as is ordinarily encountered in dam building. A comparatively impervious layer for the footing of the wall will be found at no excessive depth.

The alluvial deposits in the gorges of the Chagres River, across which the dam will be built, are composed almost wholly of a very fine sand with a large proportion of clay from the surface down for a considerable distance, the maximum depth at one point being about 80 feet. Underlying this for a distance of 100 feet or more is a thick deposit of blue clay containing little sand and some shells. Beneath this, and directly overlying the rock, is a deposit varying in thickness up to 20 feet, and containing small bowlders and angular gravels and sands thoroughly consolidated and cemented together with finely divided clays and silts. This breccia resembles somewhat the "hard pan," a "glacial till" of the northern countries. It is apparently the product of the decomposition of the immediate rock surface. Of itself it is waterproof and nonwaterbearing, hav-

ing been made so by the leaching and filling from the overlying deposits. When exposed to any powerful washing action, however, the material breaks down, the clay is dissolved and washed out, and the resulting sample has all the characteristics of a coarse gravel or sand that might be freely water bearing. That this is not the case is shown by numerous borings and samples. The artesian flows encountered in this material are probably local in their occurrence and due to the action of water which takes its pressure from the nearby hills. This water, however, is shut in by the impervious conditions of the material as a whole, and thus pent up it indicates a greater head than would be the case if it had free discharge.

(3) The borings and excavation show no continuous layer of loose sand or gravel. No deposit has been encountered that appears sufficiently extensive and permeable to endanger the proposed structure when it is performing the functions for which it is designed.

Although this is the case, on account of the composition of the upper layer and the fact that it does allow some water to pass through it even at a very slow rate, it probably will be deemed advisable to drive a cut-off wall of sheet-piling through this material and across the valley. This will afford additional resistance and effectively prevent percolation.

Mr. Saville made experimental dams on a scale one-twelfth that of the Gatun dam itself by two hydraulic fill methods and determined definitely:

(1) That suitable material is available and near at hand for the construction of the Gatun dam by the hydraulic process.

(2) That the foundations are suitable for such a structure as the proposed Gatun dam if they are properly treated.

(3) That it is practically possible to construct a stable and water-tight earth dam at Gatun of the materials available.

(4) That the hydraulic method of construction, as proposed for this work, is feasible if proper conditions are observed.

That the length of dam subjected to pressure is not excessive is shown by a table giving 500 feet as the length of dam under 85 feet head, or 36.8 pounds pressure per square inch; 2,000 feet as that subject to 30.3 pounds pressure (70 feet); 4,100 feet as that subject to 21.6 pounds pressure (50 feet); and 5,000 feet as that subject to 4.3 pounds pressure (10 feet). The length of the dam at high water is 5,100 feet. The crest of the dam is 50 feet above high water and is some 1.5 miles long, but of course all of this length beyond 5,100 feet is subject to no water pressure, nor is the upper 50 feet of the 5,100 feet of dam which is wet by the water when at its highest level. This statement alone shows the exaggerations of the statements in the daily press.

The report was made public at a time to refute by definite technical statement the exaggerations and misstatements which were prevalent and should do much to put the work of the canal engineers on the high level of public approval which its value deserves. Since the canal was put in the hands of engineers brought up in government methods of operation, the work has gone forward smoothly and successfully and now promises to continue on that line, notwithstanding the attacks of parties interested in its failure.

TECHNICAL SOCIETY PAPERS.

No excuse is necessary for the presentation of a number of papers from the various society conventions which were held during January. Their practical nature, their technical value, their application to present problems, are evident, and their publication in MUNICIPAL ENGINEERING gives them wider circulation and with greater promptness than they will get in the printed volumes of proceedings of the societies.

Mr. Wason's paper on the cost of concrete building construction ought certainly to have the effect the author desires, and the editor hopes that it will induce other engineers engaged in this and other lines of concrete construction to keep close account of their proceedings and especially to contribute to the profession the results of their work. MUNICIPAL ENGINEERING will publish whatever of value is sent for that purpose.

Another paper which should induce engineers to follow the example set is that giving methods and results of the gauging of the flow in small sewers at Cadillac, Mich., by Mr. Teed, the city engineer. Many engineers have the same problem before them and can profit by his example. If they will contribute their results to the profession at large through the pages of MUNICIPAL ENGINEERING they will confer a lasting benefit.

Mr. Tribus's description of reinforced concrete retaining walls sets forth a unique design. The editor visited the work while it was under way and was much impressed by its adaptability to the conditions and its apparent economy.

The papers come from the Municipal Engineers of the City of New York, the National Association of Cement Users and the state technical societies of Indiana and Michigan. Other good papers from these and other societies of similar kind must go over until another month on account of the lack of space to hold them all.

These societies seem to be more than usually prosperous, and the reason is to be found, no doubt, in the increasing value of their proceedings from year to year. One reacts upon the other until the results of this year are reached, which are probably only prophetic of still better work to follow.

MUNICIPAL ASPHALT PLANTS.

Last month MUNICIPAL ENGINEERING gave the results of the operation of the municipal asphalt repair plant at Columbus, O. This month we are able to give the results in Indianapolis, through the courtesy of the superintendent of the plant. Figures from Detroit were promised, but have not arrived in time for publication this month. Further detail of the New Orleans plant, reported briefly in a recent number, will also be given later.

While these results are not reported upon the same basis, the figures are stated in as nearly the same form as possible, so that they may be comparable, at least in part, as far as they go. The missing items in each case are largely matters of opinion or methods of bookkeeping and one interested in the design of a plant for a particular city can supply such items as interest on cost, depreciation, general superintendence and expense, to suit his local conditions. The variations in prices of materials may be seen from the reports, although the data are not as fully stated as they might be. Wages and quality of labor are not so easily judged and the comparisons in this respect can not be made.

It should not be difficult for the small number of experts in charge of these plants to agree upon a certain uniformity in reports which will make them much more valuable. A careful comparison of the data from the four plants named should enable the superintendents of all to approximate closely the same form even without communication with each other.

THE NEW YORK GAS RATE LAW.

In 1905 the state legislature of New York passed two laws, one making the maximum price of gas to the city of New York 75 cents a thousand cubic feet and the other making the maximum price to other patrons of the company 80 cents. The company failed to obey the law, and in 1906 suits were filed against the State Gas Commission, the city of New York and the Attorney General of the state, to enjoin the enforcement of the acts and the order of the Gas Commission thereunder, on the ground that the rates fixed were confiscatory and the laws and order therefore unconstitutional. The hearing was held before a master, who reported in favor of the gas company, and, after final argument, the United States Circuit Court, in which the suit was brought, decided in the company's favor and issued an order restraining the enforcement of the commission's order and the acts.

Each of the defendants appealed to

the United States Supreme Court, and the decision on these appeals was made January 4, 1909, reversing the judgment of the lower court and permitting the enforcement of the order. This decision is based on the opinion that proof of insufficiency of rate to bring a fair return on a reasonable valuation of the property of the company was not complete. This difference from the opinion of the lower court is based on the belief of the higher court that the franchise values are $7,781,000, and not $12,000,000, and that they have that value for the purposes of this litigation only because such value was fixed in 1884 under an act authorizing the consolidation of the gas companies of the city, and that good will should not be included in the valuation of a monopoly; the uncertainty of the expert valuations of the company's property, which include the estimated increases in value since the real estate was purchased and the estimated changes in value of the plants since their construction, and in which a slight change in basis of estimates would produce a material reduction; and the probability that the reduction in rate will produce an increase in business which will in part offset the reduction in income caused by the reduction in rate. The court therefore believes that the income may be able to pay 6 per cent. interest on the reasonable valuation of the plant, which interest has been assumed throughout the opinions and decisions as a fair return on that valuation. This can be proved only by an actual test, and the enforcement of the law is therefore permitted until such time as the company shows by actual results that it cannot earn this interest. In 1905 the net income of the company would have paid over 10 per cent. on the valuation fixed by the Supreme Court.

The other objections are dismissed as immaterial or capable of adjustment.

Notwithstanding the discrepancy between the capitalization of $73,177,000 and the valuation by the court of $55,612,435, the stock market, on recovery from the effects of the decision, has settled on a valuation of 125 to 130 for Consolidated Gas Company stock having a par value of 100, the bid price on January 18 being 128¼ and the asked price ¼ higher. This indicates that the market believes the returns will be greater than 6 per cent. on the valuation, or is satisfied with less than 6 per cent. on its investments in the stock.

On the other hand, a deal involving the transfer of one small gas plant in the state, the ending of the receivership of a second and the supply of a third village by a high-pressure line was spoiled, the prospective purchasers declining because they would not be satisfied to conduct a hazardous manufacturing operation where they would be called upon to turn over to the consumers all profits over 6 per cent. after they had taken the risks of little or no returns in developing the business.

This position is evidently one of criticism of the justice and efficiency of the Public Service Commission rather than of the court's opinion that 6 per cent. is sufficient return. For the prospective investors would probably agree with their fellow-patrons of the stock market that they would be satisfied with 6 per cent. on their investment from the beginning, and a fair commission, in following the court's lead, would probably allow that return, and therefore permit rates high enough to produce it for the full period of the investment before taking steps to have the rates reduced.

Some allowance may be made for an exhibition of temper over a decision contrary to the desires of the investors, and at the present time for some doubt of the procedure of a commission as yet but slightly tested; meantime the aforesaid investors have probably let slip an opportunity for a good investment under conditions which insure adequate returns, the risks of accident and the effects of bad management excepted.

THE QUESTION DEPARTMENT

Location of Leaks in Water Mains.

When our mains were put in, some of the joints were not properly calked, and where the ground is gravelly the leak does not show on top of the ground. By means of the aquaphone and meter we can ascertain they are leaking, but we cannot find the place without digging up each joint, which is both expensive and a damage to the road. I have heard that there are other means of finding these leaks. Do you know of any? This information would doubtless be of value to many of your readers, as the loss of water through leakages of one kind and another is an important item in their expenses.

O. O. L., Canisteo, N. Y.

Can our readers give any information on this subject? The only successful methods known to the writer depend on apparatus such as that mentioned. Numerous well-located valves will permit the reduction in length of pipe to test down to, say, the length of a block or two, and will thus reduce the number of joints to be dug up and the number of house connections to be shut off at a time to a minimum. The leakage in a pipe system takes place at joints, at the corporation cocks, and in the house connections, that in the latter being in pipes and in fixtures. To locate the leakage in the joints and corporation cocks in the street mains, the house connections on the line should be shut off. Practice with the apparatus will give the operator some facility in judging the amount of leakage, and, if concentrated, the distance of the leaky joint from the point of observation.

Location of Leaks in Water Mains—Durability of Concrete Sewers.

Is there any method or instrument that can be used to locate leaks in cast iron water mains when under a cover of 6 to 8 feet? If so, where can the instrument be obtained and what will be the cost? I am often called upon to locate leaks in water mains where the leak does not show upon the surface, and it is several blocks between the valves, and I want to know if there is an instrument that will locate by sound or otherwise within a few feet of the leak, without having to excavate the entire distance between the valves.

Will cement pipe or reinforced concrete sewers last as long when laid and in use for sanitary sewers as salt glazed sewer pipe? Will the sewer gases and acids tend to eat up and decompose the cement in the cement pipe or reinforced concrete sewers?

W. C. F., Rochester, Minn.

For information regarding the first question see the question under the same heading on another page. If a rod can be driven down to contact with the pipe, some indication might be obtained by an expert. Possibly our readers may have some experiences which they will be willing to share with these two inquirers and many others.

The second question, regarding the durability of cement in sewers, is now under discussion, and there are many expressions of opinion. Cement has been used in sewers in mortar for brick work and in cement pipes for forty to sixty years, and old work is still in good condition and likely to remain so. Poor jobs have failed and been replaced. The same is true of vitrified sewer pipe. The question is therefore very largely one of quality of materials and workmanship. Cement sewer pipes, plain or reinforced, are made on the surface of the ground and can be inspected as thoroughly as vitrified pipes. Porous concrete may disintegrate in time. Dense concrete has the prospect of long life. The ordinary sewer gases and acids do not affect concrete, and there are only one or two reasonably well-authenticated reports of discharge from factories sufficiently acid to attack concrete. It has been suggested that the chemical action in septic tanks, where sewage stands until partly decomposed, affects concrete, but no definite reports of actual observation have been made public as yet. Alkaline soils are reported to have a detrimental effect upon concrete sewers and cement mortar in brick sewers in Dakota, as reported in several numbers of MUNICIPAL ENGINEERING last year, but this action is local and has not been observed in all alkaline soils, because all alkaline soils are not of the same composition. It is suggested that this effect is due to porosity of the concrete and the seepage of alkaline water through it, and that dense concrete or waterproofed sewers would be safe. Under ordinary conditions, therefore, the relative durability of cement sewers and vitrified pipe sewers depends upon the qualities of material and workmanship. Reinforced concrete sewers can be made of any desired strength and may be preferable on this account where heavy weight must be borne by the sewer.

Information About Water Filtration.

I am much interested in securing a filter system for our water works, and would be glad if you would refer me to some good authority on filtration plans. If any of your back numbers contain any articles on filtration, with any drawings or plans of the plants, we would be pleased to have them.

J. W. C., ———, Tex.

Reference may be made to the "Busi-

ness Directory" published in each number of MUNICIPAL ENGINEERING, under the headings "Civil Engineers" and "Consulting Engineers," especially those making specialties of water supply and water purification.

Books on the subject are Hazen's "Filtration of Public Water Supplies" ($3), "Fuertes's "Water Filtration Works" ($3.50), Rideal's "Water and Its Purification" ($3), and some chapters in Turneaure and Russell's "Public Water Supplies" ($5).

Articles on the subject in MUNICIPAL ENGINEERING are as follows in the more recent volumes:

"Importance of the Proper Operation of Water Purification Plants," vol. xxxv, p. 352.

"Cost of Operating Sand Filters," vol. xxxv, p. 252.

"The Collapse of the Lawrence, Mass., Filter Roof During Construction," vol. xxxiv, p. 138.

"Purification of Water Supply at Lawrence, Mass.," vol. xxxiv, p. 209.

"The Removal of High Turbidity from Water without the Use of Coagulants," vol. xxxiv, p. 240.

"Results of Filtration Experiments and Water Waste in Washington," vol. xxxiii, p. 112.

"Progress on Philadelphia Filtration Plant," vol. xxxiii, p. 114.

"The Water Filtration Plant of Harrisburg, Pa.," vol. xxxiii, p. 155.

"The Water Purification Plant of Harrisburg, Pa.," vol. xxxiii, p. 221.

"A New Slow Sand Filter for Lawrence, Mass., vol. xxxi, p. 92.

"The New Orleans Water Works," vol. xxxi, p. 429.

"Filter for Small Reservoir," vol. xxx, p. 349.

"Operation of Sand Filters of Indianapolis Water Works," vol. xxix, p. 6.

"The Use of Copper Sulphate in Purifying Water at Anderson, Ind.," vol. xxix, p. 28.

"The Water Filtration Plant of the Kolar Gold Field at Mysore, India," vol. xxviii, p. 91.

"Progress in the Filtration of Public Water Supplies," vol. xxviii, p. 108.

"The Sand Filtration Plant of the Indianapolis Water Works," vol. xxviii, p. 321.

"Removal of Iron from Ground Water," vol. xxviii, p. 472.

Sewers in Alleys.

Could you inform me of any cities or towns where the method of putting the sewers in the lanes is adopted, also your opinion of this system? Do you consider it a good system where combined sewers are used?

A. J. LATORNELL, Acting City Engineer,
Edmonton, Alberta.

This is a question, the answer to which must be made after a special study of the local conditions. At first sight, the location of house sewers in the alleys seems better, partly because they may be nearer the house system outlet and the stable, partly because it is likely to be easier to reach the sewers in the alleys than in the streets, partly because the interference with travel and with paved streets is much less, and partly because all these things may reduce the cost. The word "may" is used because local conditions change one or more of these items so that arguments against the location in the alleys are produced.

For sewers on the combined plan the drainage of the streets enters as another factor. In a new town, like Gary, Ind., where the sewers were located before the streets were built, and the streets are very level, gradients being largely artificial, the catch basins or inlets for storm water from the streets can be located at the alleys and no extra length of catch basin connections is required. This makes the location of sewers in alleys still cheaper, because the catch basins may be located almost over the sewer, instead of half the width of the pavement or more away from the sewer, as happens when the sewers are located in the streets.

The design of the paving intersections also enters as a factor. The water from the streets parallel to the sewers in the alleys must be drained in the gutters around the corners and down to the sewer inlets, making a flow of storm water around the corners which pedestrians must cross in crossing the streets. This necessitates bridges and flattening of the cross-sections of the streets or some equivalent scheme to keep the pedestrians out of the water. The plan mentioned makes rough and inconvenient surfaces for vehicles to pass over when traveling off the center line of the streets, and especially when turning off of one street onto the cross street. It may be, in some cases, that inlets at the street corners, with connections to the sewers in the alleys, would be cheaper than the location of the sewers in the streets.

Another important factor in the decision is the regularity of the plats of the additions to the city. Streets are more regular than alleys, ordinarily, and a sewer plan which is good for one part of the city is not applicable to another part. The writer has found in his own practice that it is usually necessary to modify the plan on this account. Having in mind a preference for the location of the sewers in the alleys, he locates the sewers in the streets when that location proves to suit the conditions the best, and thus has in the same city both methods of location in the plans, because the conditions almost always vary enough in the different parts of the city to make this necessary.

Relative Popularity of Paving Materials.

Owing to a question which came up at the University of Maine on the subject of highway engineering, I write you for a bit of data. What I want is a list of the comparative amount of the different pavements used since 1905; the number of miles of concrete pavement in actual use in the city of New York.

A. M. B., Orono, Me.

The only source of information of any extent upon this subject is in the statistical reports of cities of over 30,000, issued by the United States Department of Commerce and Labor for the year 1906, and previous issues. Reports from part of the boroughs of New York show no concrete pavements, and in the other boroughs there is very little, if any, of this kind. Partial reports regarding asphalt, brick and bitulithic pavements are given in the department, "From Workers in the Field."

Ordinance Providing For Taking City Census.

Kindly send me a form of a proper ordinance providing for taking the census of a city of the fourth class for the purpose of organizing as a city of the third class.

R. H. D., ———, Mo.

The census may be taken by the police force or by the force in some city office, perhaps with additional employes temporarily, or the work may be let by contract. The ordinance would differ according to the method selected. In general it should provide an order to take the census under the provisions of the statute governing the matter; assign the work to the department or office intrusted with it; provide for additional employes, if necessary, and their compensation; fix time of beginning and completing the work; provide method of letting contract and paying for the work in case that procedure is determined upon; make appropriation for payment of cost.

Can any of our readers supply forms of ordinance in use?

Information About Septic Tanks and Well Boring.

I wish to inquire where I can get information concerning the designing and building of septic tanks, and also general information as to their utility. Do you know of any good books giving such information? Also have you any information on well digging in soft material and hard-pan 250 to 300 feet in depth.

D. F. G., Portland, Ore.

Good books on the design and construction of septic tanks are Raikes's "Design, Construction and Maintenance of Sewage Disposal Works" ($4 net) and Venable's "Methods and Devices for Bacterial Treatment of Sewage" ($3). A review of the latter book will be found elsewhere in this number of MUNICIPAL ENGINEERING.

Isler's "Well Boring for Water, Brine and Oil" ($4) is said to be the latest and best book on its subject.

These books can be supplied by MUNICIPAL ENGINEERING at the prices quoted.

Cost of Building Construction.

We are advised by the Portland Cement Co., of Jackson, Mich., that you publish a pamphlet giving the costs of different kinds of construction work. As we shall probably be erecting a good sized building within the next fifteen months, we are studying the different forms, with relative cost of construction, and would like very much to have a copy of your pamphlet, especially if it deals with concrete construction.

F. G. Co., Detroit, Mich.

The "Hand Book for Cement Users" ($3) gives data regarding the cost of concrete construction. The building referred to would doubtless be of reinforced concrete construction, and in that case the information in that book should be supplemented by such books as Gillette's "Hand Book of Cost Data" ($4), which has information on comparative cost of various methods of building construction, or Kidder's "Architects' and Builders' Pocket Book" ($5), which has much on methods and quantities in building construction, including concrete and reinforced concrete, and some cost data. Gillette and Hill's "Concrete Construction Methods and Cost" ($5) has some data on cost of building construction in concrete and reinforced concrete. See also the article on cost of reinforced concrete building in this number of MUNICIPAL ENGINEERING.

Information About Concrete for Posts and Other Farm Uses.

I have recently run across an article in your magazine for May, 1905, in regard to "Concrete Fence Posts, Boundary Stones and Watering Troughs," by Paul Wilkes. I note that you state that further information may be obtained by addressing your paper. If you now have data of interest on any one of these subjects, we shall be much pleased to receive it, or to to be referred to where we may obtain it.

W. O. L., Newton Highlands, Mass.

The following articles have appeared in MUNICIPAL ENGINEERING upon this subject since the date mentioned:

In vol. xxviii: "Cement Castings," p. 453; "Plastic Fence Post," p. 455; "Elposco Concrete Blocks and Posts," p. 488.

In vol. xxix: "How to Manufacture Window Sills, Door Sills, Door Steps, Mold Construction, etc.," by Paul Wilkes, p. 127; "How to Build Watering Troughs or Tanks," p. 294; "How to Build a Circular Water Tank," p. 349; "Machine for Making Steel-Concrete Fence Posts," p. 381.

In vol. xxx: "The Use of Cement for Farm Purposes," p. 99; "The Monarch Cement Post and Fastener," p. 163; "The Crouch Block and Post Molds," p. 313; "A Trussed Concrete Post," p. 463.

In vol. xxxi: "Concrete Tanks and Silos," p. 277; "Concrete for Farm Buildings," p. 278; "Construction of Silos," p. 399.

In vol. xxxiii: "Cement Post Problems," p. 253.

In vol. xxxiv: "Reinforced Concrete Lining for Reservoir," p. 238; "Methods of

Making Concrete Poles," p. 302; "Fence Posts," p. 363.

In vol. xxxv: "Patents on Concrete Posts and Poles, Burial Vaults and Tombstones," p. 267.

There are doubtless other articles in these volumes that would be found useful.

The "Handbook for Cement Users" ($3) may also be referred to.

There is considerable German literature on this subject. The latest article on file in this office is one on "Grenz und Kilometersteine aus Beton," in *Zement und Beton*, 1908, No. 48.

Design for Concrete Road Bridge.

We are going to build some concrete bridges here in the country. I would like to get some information in regard to a bridge of 20-foot span between piers and 16-foot roadwya. What I want to get at is the best way of reinforcing such a structure. C. E. S., Kingfisher, Okla.

Will our readers send us plans for bridges of this description which they have built, for publication, in response to this request for information? The bridge may be of either arch or beam construction. The various makers of reinforcing bars issue booklets and make plans which show how to use their materials, and these can be obtained on request. Names of firms who can furnish information of this sort will be found in the "Business Directory" printed in each number of MUNICIPAL ENGINEERING, under the headings "Bridges," "Concrete Steel Arch Bridges," "Expanded Metal Construction." The engineers whose names are found under the headings "Civil Engineers" and "Consulting Engineers" can also give information and assistance suited to each particular case.

Good articles on this subject will be found in MUNICIPAL ENGINEERING, among them the following:

"Reinforced Concrete in the Construction of Highway Bridges and Culverts," vol. xxxiv, p. 277.

"Design for Concrete Arch" (28-foot span), vol. xxxiv, p. 239.

"Sufficiency of Concrete Arch," vol. xxxiv, p. 167.

"Methods and Costs of Concrete Construction with Separately Molded Members," vol. xxxiv, p. 74.

"Sufficiency of Plans for Arch," vol. xxxii, p. 18.

"Concrete Floors for Bridges," vol. xxxii, p. 318.

"Thickness of Concrete Floor Slab," vol. xxxii, p. 86.

"Reinforced Concrete Tower and Floors," vol. xxxii, p. 87.

"Reinforced Concrete Bridge on East Washington Street, Indianapolis, Ind." (60-foot span), vol. xxxi, p. 1.

"A Low Cost Concrete Culvert" (12-foot span), vol. xxxi, p. 315.

"Renewing Railroad Waterways with Concrete Culverts," vol. xxxi, p. 9.

"Breaking Strength Formulae for Concrete Beams," vol. xxix, p. 347; vol. xxx, p. 357.

"The Strength of Reinforced Concrete," vol. xxix, p. 167.

"Reinforced Concrete Arches" (of 45 and 95-foot spans), vol. xxviii, p. 442.

"Concrete Bridge Failure" (12-foot span), vol. xxviii, p. 207.

"A Skew-Arch of Concrete-Steel," vol. xxviii, p. 7.

"The Iowa State Highway Commission's Designs for Culverts," vol. xxviii, p. 389.

"Concrete-Steel Bridges at Dayton, O.," vol. xxvii, p. 83.

"Concrete Arches for Railroads," vol. xxvii, p. 168.

"Stability of Concrete Bridge" (20-foot span), vol. xxvii, p. 372.

"Strength of Reinforced Concrete Beams," vol. xxiii, p. 126; vol. xxvii, p. 414.

"Articles on Reinforced Concrete," vol. xxvi, p. 167, giving a list of previous articles on the subject.

"A Concrete-Steel Highway Bridge," vol. xxv, p. 392.

"Dimensions of Concrete Arch," vol. xxiv, p. 436.

"A Steel Centered Concrete Arch," vol. xxiv, p. 453.

Instructions as to design and some examples of actual structures and reinforcement used will be found in the following books: Buel and Hill's "Reinforced Concrete" ($5); Taylor and Thompson's "Concrete, Plain and Reinforced" ($5); Turneaure's "Principles of Reinforced Concrete Construction" ($3); "Handbook for Cement Users" ($3); Reid's "Concrete and Reinforced Concrete Construction" ($5); Sabin's "Cement and Concrete" ($5); Marsh's "Concrete" ($3).

General rules for amount and location of steel reinforcement may be safe under good conditions, but they should not be applied indiscriminately. It is better to apply to a competent engineer for designs, or to the makers of reinforcing materials, who have such engineers in their employ.

Effect of Freezing on Concrete.

Please ask your correspondents to give their experience on the freezing of concrete. I think such articles would be of great interest to all concrete users in this western country. I have in the last year had a great many arguments on the subject. J. O. L. B., Billings, Mont.

This request is referred to our readers. The effect of freezing on concrete has not been sufficiently observed as yet to make certain under all circumstances any theory that has been advanced.

Cold retards the setting of cement, and cold enough to cause the freezing of the water in the mortar or concrete stops the chemical action called setting. Most observations show that this stoppage is complete, and that it begins again when the concrete thaws out, so that it is only necessary to wait for this thawing in order to arrive at the same result that would

have been obtained promptly if the temperature had not been lowered. There have been occasional reports which did not agree with this general conclusion. They have been attributed to incorrect observation, to chemicals in the cement which do not belong there and which continued their action in such a way as to prevent the continuance of the setting after the thawing, to the expansive action of the ice when formed, etc., and each of these may have been true in one or more cases. As a rule, however, it is only necessary to keep the forms in place until the cement has actually set, whether this is a few days or several months. Removal of forms at too early a stage has always resulted in disaster, even if they had been in place for weeks.

If the concrete is subjected to alternate freezing and thawing during the process of setting, the result will probably be different. Possibly the partial set obtained during the first thaw corresponds to the set in the mortar box of mortar left too long, so that the second and following periods of thawing correspond to retempering of old mortar, and, if continued, result in disintegration of the concrete. Possibly the separation of the water from the mortar by the formation of the ice and the expansive action of the forming ice crystals are the disintegrating forces. At any rate, the numerous cases of alternate freezing and thawing of concrete before the set is completed, which have resulted in disintegration, show that this action is very dangerous to the integrity of the structure.

There are numerous methods of preventing freezing until the set of the cement is completed. If our readers will report their experience with them for the department, "From Workers in the Field," they will interest many of their fellow-workers.

Tennessee Portland Cement Co.

We understand there is a cement plant to be erected at Cumberland Gap, Tenn. Are you in a position to give us the name of same, or the name of one of the officers. B. V., New York City.

A plant is proposed at Cumberland Gap, Tenn., and the name of the company expecting to build it is reported to be the Tennessee Portland Cement Co. W. J. Oliver, the well-known contractor of Knoxville, Tenn., is said to be the principal mover in the project.

Machinery for Screening and Mixing Stone.

Is there machinery for grading granite screenings for the manufacture of concrete blocks and sidewalks? I mean the separation of the granite screenings into various sizes and then their combination into a mixture of certain definitely determined sizes to produce the minimum of voids.

With that mixture, what proportions of cement would you advise? When I use crusher run granite screenings to manufacture blocks I make it 1 to 4, and for sand 1 to 3 or 3½. What proportions of the mixture would you advise for sidewalk top course?

IGN. BILODEAU, Quebec, Can.

The process described is that invented by Fred J. Warren to prepare stone for the bitulithic pavement, and machinery has been invented to carry on the process. The theory of the process and the method of determining the proper sizes and proportions of sizes of stone to produce the minimum of voids are stated in an article in MUNICIPAL ENGINEERING, vol. xxv, p. 99. The apparatus which performs the operations consists of a dryer, since the stone must be dry in order to separate the dust and the smaller sizes effectually, and, in the case of the bitulithic pavement, must be hot; a set of screens of the meshes determined upon for the particular stone in use; bins for the storage of the various sizes, which discharge into a box on a special form of scale which automatically weighs the amounts of each size required; and a mixer for mixing the sizes together and adding the cement.

The proportion of cement to be used depends upon two factors, the voids to be filled and the covering of every particle of stone and sand with a film of cement. With the ordinary stone screenings or sand the proportion of voids is so great that it is customary to add to the amount of cement required to fill the voids, say 10 per cent, largely to allow for inefficiency in mixing. The voids may be reduced in the laboratory below 10 per cent by the process of separating and then remixing selected sizes, and well below 15 per cent in actual practice. The mixing must be more thoroughly done after the cement is added than in the ordinary case, to insure thorough incorporation of the cement, and it will be an error on the side of safety to add perhaps 20 per cent to the amount of cement. Thus if the voids would require proportions of 1 of cement to 8 of the stone mixture, the increase of 20 per cent in the amount of cement would make the proportions nearly 1 to 6, which would probably supply enough cement to coat completely every grain of the aggregate if the mixture is thoroughly made.

Formerly proportions of 1 cement to 1 fine granite screenings or coarse sand was used for the top surface of sidewalks. It has been found in practice that proportions of 1 to 1.5 produce better results; that is, less danger of hair cracks, and, with a hard and tough aggregate, a more durable walk. Some engineers and contractors assert that proportions of 1 to 2 give equally good results. The selection of sizes proposed for the concrete blocks and the lower course of sidewalks would have less application to the top surface, because the aggregate for the top surface is made up of the smaller sizes, without the

dust, and the proportions of voids must therefore be greater.

Will our readers express their opinions on this subject, especially if they differ from those stated?

Guaranties of Street Paving.

This town has recently, by contract, paved and curbed a street. Neither the paving nor the concrete curbing was done according to the contract, but especially the latter was poor, so admitted by the city authorities, who, however, are disposed to accept the paving as being according to contract and to accept the curbing, provided a bond is given for its repairs and future condition, contract covering a period of several years. Inasmuch as the curbing and the pavement were all in one contract, has the city any right to separate the two, accepting one and practically admitting that the other is not according to contract?

Has this point been discussed in MUNICIPAL ENGINEERING, or is there published a book containing decisions on street improvements?

Here is an instance where the curb is actually worthless, yet they propose to receive it under a guaranty, frankly admitting all this, although the original contract calls for good work and makes no provision for any open door as to repairs, bonds or guaranties. F. C., ——, Mo.

This is really a question for an attorney familiar with the local conditions and with the Missouri laws. The proposed guaranty seems to be entirely outside of the regular contract and in the nature of a separate contract made between the city council and the contractor, and, as such, need not be affected by any of the provisions of the original contract. There may be some Missouri statute or court decision which would render the secondary contract void, but probably there is not.

Guaranties of work done are of two kinds, those which are intended to cover any defects in materials or workmanship which have escaped detection by inspectors, and those which cover the behavior of materials concerning which the officials are in doubt. The first kind of guaranty has its warrant in the common fact that municipalities, from ignorance or lack of money, do not supply competent inspectors in sufficient numbers to insure the grades of materials and workmanship required by the contract. They are assumed to have sufficient length to cause any unobserved defects to develop.

The second kind of guaranties had its full development during the period of introduction of asphalt pavements. No one knew the properties of the new paving material, but the asphalt paving companies had a few men who had learned by practice how to lay asphalt and who were successful more often than not. The prices paid for the pavements were high enough so that the companies could afford to guarantee that the wearing surface would last a certain number of years and replace the small proportion of paved surface which proved defective. Our knowledge of paving materials is much more extended at the present time, and there are may men who know their qualities and the methods of making pavements with them, both theoretically and practically, and are not connected with the paving companies. A guaranty of the second kind at the present time is therefore a confession of ignorance or of unwillingness to employ the expert aid which is available, for lack of funds or some other reason.

In the case covered by the question there seems to be no guaranty in the original contract, but, if our correspondent is correct, the contractor wishes the city to accept his work with the knowledge that it is not equal to specifications, but with his guaranty that it is "good enough," and that if its defects should develop within the proposed period of guaranty he will replace the defective portions. What could be done by the property owner assessed for the pavement in enjoining such a contract or in securing a rebate or a court decision that this supplementary contract makes the assessment void, is a question for an attorney versed in Missouri laws, practice and court decisions.

Some discussion of the general principles of guaranties will be found in MUNICIPAL ENGINEERING, vol. xxxiii, pp. 331, 338 and 340, and vol. xxxiv, pp. 19, 87, 367. In vol. xxvi, p. 407, will be found a list of a number of court decisions printed in previous numbers, and still more have appeared which are not in the list. None of these apply directly to the question, which is of such nature that a decision of any case containing it, in a local court, would be accepted as final and would not reach the higher courts, whose decisions are given in the publications devoted to the collection of cases. Perhaps our readers know of such cases and will report them.

Snow-Melting Machine.

In addition to the article on the above subject in MUNICIPAL ENGINEERING, vol. xxxv, p. 315, attention may be called to a machine invented by Jacob Mandrey, of Wakefield, N. Y., consisting of a furnace on wheels, with a scraper which lifts the snow off the ground far enough so that an endless belt conveyor drags it up over the inclined top of the furnace, where it is supposed to be melted, the water running back on the ground. The fact that nothing has been heard of the furnace since about the date of its patent, some seven years ago, is an indication that it attempted a larger task than it could properly perform.

Ordinances Governing Smoke Prevention.

I have been referred to you by Mr. Lester of the State Library, New York, as "the best source for immediate and thorough information on municipal ordinances." I am interested in the "smoke nuisance" question. Can you tell me whether any compilation has been made of municipal ordinances on this subject;

if so, where it can be obtained and at what cost. I am a member of a committee of the Court of Common Council which has this subject under consideration, and it is probable that the matter will be taken up in the State Legislature this month. H. M. S., Hartford, Conn.

The smoke ordinance of the city of Indianapolis is probably as good as any which has been passed. It will be found in MUNICIPAL ENGINEERING, vol. xxxi, p. 38. It has served to some extent as a model for other ordinances. A list of cities having smoke prevention ordinances will be found in vol. xxx, p. 351, which can be extended somewhat if desired.

The International Association for the Prevention of Smoke is a new organization made up largely of smoke inspectors, and its officers can doubtless give full information at least regarding the cities represented in its membership. John Krause, the supervising engineer in charge of smoke prevention work in Cleveland, O., is president, and R. C. Harris, property commissioner in Toronto, Ont., is secretary.

The following articles in MUNICIPAL ENGINEERING, written by experts, will be of value in the study of the problems:

"Steps in the Development of a Smokeless City," vol. xxxii, p. 252.

"Smoke and Its Abatement," vol. xxx, p. 65.

"The Abatement of the Smoke Nuisance," vol. xxix, p. 366.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited. Give from your experience for the benefit of others. No matter about the style of the composition, the fact is what is wanted. Use the Question Department for what you want to know; use this Department for what you can tell others.

Efficiency of Hydraulic Ram.

To the Editor of MUNICIPAL ENGINEERING:

Sir—With reference to the hydraulic ram desired by your correspondent, in the January number, vol. xxxvi, p. 36, while we would not recommend a Rife ram under the conditions stated to pump directly to the 200-foot elevation, as our limit is about a ratio of 1 to 30, we could guarantee an efficiency of at least 50 per cent. by using one machine to pump sufficient water to a certain elevation, where a smaller machine could be located to pump to the 200-foot level.

If 8 feet fall can be secured, our rams will pump directly to the 200-foot elevation with a guaranteed efficiency of at laest 50 per cent. Under normal conditions 70 per cent. is guaranteed.

B. L. GREEDER, President,
New York City.

Prevention of Freezing of Hydrants.

To the Editor of MUNICIPAL ENGINEERING:

Sir: I have been trying a method of treating bad hydrants this winter, which, so far as I know, is new.

I suppose all small cities have some hydrants which do not drain properly, and I am anxious to know whether my idea has been tried out before I go any further.

I have twelve which are set in low ground, where it would involve considerable expense to drain, and they stand full of water to the ground level and, of course, freeze in cold weather.

I have experimented with one of them by filling to about 6 inches from the top of the valve to the water level with kerosene oil, thus forcing out the water and yet leaving the valve protected from the oil. While I have not had a severe test as yet, I see no reason why it will not prevent freezing under practically any condition.

I will be pleased to have criticisms.

H. E. H., Salamanca, N. Y.

Will our readers comply with the request for criticism and describe their own methods?

Effect of Temperature on the Setting of Concrete.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Although it has been generally assumed that the temperature has considerable effect both on the time required by concrete for setting and on the ultimate strength of concrete, authentic information has been lacking with regard to the matter. Especial interest, therefore, attaches to the series of tests which have been undertaken in the Quincy Market

Cold Storage Warehouse of that city. Here ideal conditions are presented for experiment through a wide range of temperatures. In all tests so far conducted the material, including the water used in the samples, was left for twenty-five hours in the room, where the temperature was above freezing. The samples were made up in this room and left there until the time for testing, when they were covered up so as to preserve the same temperature, taken to the laboratory and immediately tested. The result, with the cement chemist's comment, follows. All samples were left in air, without immersion in water.

Temperature of Air and Materials.	Initial Set.	Final Set.	Mixture.	Average Tensile Strength in Pounds Per Square Inch. 24 Hrs.	7 Days.	28 Days.
72 degrees.....	45 min.	3 hrs. 50 min.	Neat.	290	457	443
			1 cement 3 sand by w'ght	....	168	168
41 degrees.....	45 min.	8 hrs.	Neat.	29	514	583
			1:3.....	....	189	221
34 degrees.....	45 min.	8 hrs.	.....	17	417	508
			1:3.....	....	127	202
34 degrees (room, 7 degrees). Froze solid in 10 min. Cement soft on melting; no set.						
Sample 24 hours in —7 degrees and 24 hrs. in 72 degrees			Neat.	....	75	....
Sample 7 days in —7 degrees and 24 hrs. in 72 degrees				No strength owing to cracks.		
Sample 7 days in —7 degrees and 7 days in 72 degrees			.....	28	....	....
Sample 7 days in —7 degrees and 24 hrs. in 72 degrees			1:3	....	29	....
Sample 7 days in —7 degrees and 7 days in 72 degrees			.....	....	28	....

On this test all neat briquettes cracked badly when allowed to stand in normal temperature.

The cement chemist, Mr. H. L. Sherman, states in his report that in the two coldest rooms, at 6 degrees and 7 degrees below zero, F., the cement froze very quickly, and when the briquettes were removed from the cold room to the temperature of this laboratory, they thawed out and were fairly soft again. These briquettes showed no strength on thawing, but some were allowed to stand for different times in this temperature, with the results indicated on the report sheets. Other results are to follow on briquettes made for a longer period.

It is very interesting to note that the temperature of 41 degrees seems to give the best results, even at seven days.

It appears that this better strength at the lower temperatures may be due to the slower rate of evaporation of the water, and hence to giving the cement its ideal condition in connection with water for a longer time. Of course, where the water was frozen, this does not apply. This theory is borne out by the fact that the percentage of increase is greater on the 34-degree tests than on the 41-degree.

ABERTHAW CONSTRUCTION CO.,
Boston, Mass.

Cost of Asphalt Repairs in Indianapolis.

To the Editor of MUNICIPAL ENGINEERING:

Sir: We are enclosing herewith one of our reports for the year 1908.

In regard to the depreciation, it was figured on a basis of 5 per cent per annum on the total investment of $20,557.68, and interest was figured on same basis and rate. Interest and depreciation cover a period of six and one-half months length of time that plant has been in operation.

Cost of work varied greatly with the conditions under which it was done, ranging from 42 cents per square yard to $1.57 per square yard for the asphalt surface. In this connection I will say that our pavements in this city, which are out of guarantee, will not average more than 1½ inches in thickness.

Our maltha California asphalt cost $23 per ton; Trinidad asphalt, $20 per ton; limestone dust, $3 per ton; residuum averaged 5 cents per gallon; sand, 90 cents per cubic yard; common labor, 20 cents per hour; asphalt experts, $2.50 per day of eight hours; teams, $3.50 per day; roller engineers, $3.50 per day; foremen, $4 per day. Concrete work in private cuts averaged $1 per square yard.

SAMUEL R. MURRAY, Superintendent,

Asphalt Repair Plant, Indianapolis, Ind.

Work commenced on the municipal asphalt repair plant on April 16, 1908, and the first asphalt mixture was turned out on June 16, 1908.

Between June 16 and December 31, 1908, there were turned out by the plant 14,798 boxes of surface mixture for our own work and 1,893 boxes of surface mixture for the West Michigan street resurface. There were also turned out 373 boxes of binder for our own work and 1,357 boxes of binder for West Michigan street resurface, making 1,730 boxes binder and 16,691 boxes surface, a total of 18,421 boxes of mixture turned out in this time.

The total cost of asphalt plant, one 5-ton steam roller (asphalt), four dump wagons, fire wagons, office building, roller, stone dust, and tool sheds and all tools necessary to carry on this work, amounted to $20,557.68. This also includes the cost of grading off the yard for plant, putting brick driveway under mixer, cement floor around cold sand elevator.

The repairs and private work done by

the plant comprise 52 different streets. Repairs on some of the streets were very extensive, as in the case of South East street from South to Morris, where about one-half the wearing surface was missing and holes were worn entirely through the concrete in some places. On East Washington street between Noble and Southeastern avenue; South Delaware between Maryland and Union tracks; Kentucky avenue between Missouri and River avenue; Capitol avenue between Maryland and Union tracks; North Senate avenue between Indiana avenue and Tenth; Prospect street between Shelby and State; McCarty street between East and New Jersey; and on Shelby street there were places almost impassable on account of spots where was the concrete was worn entirely through the sub-grade, caused by delay in making repairs, before the plant was started. The extra concrete necessary to bring the base up to grade for asphalt surface amounted to 4,026 square yards, and ranged from 2 to 6 inches and cost $1,399.66. There were also 441 square yards of 6-inch concrete in private cuts, making a total of 4,467 square yards of concrete laid by this department.

There was also laid on West Michigan street between Blake street and the White River bridge 9,504 square yards of 2-inch asphalt surface and 1-inch binder. This work was laid by the Barber Asphalt Company in 1906 and was re-surfaced by the city with genuine Trinidad Pitch Lake asphalt. The total cost of removing old material and re-laying this 9,504 square yards was $10,763.83 or $1.132 per square yard, and as this was separate from our own repairs our fund should have credit for this amount, as the work was paid for from our fund.

The total amount of private work for water, gas, electric, heating, street railway and plumbing companies, since starting the plant until December 31, aside from West Michigan street, amounts to 7,540 square yards, and the money paid or due the city controller for this work amounts to $12,330.72, for which amount our fund should be credited.

On January 1, 1909, there was on hand and paid for material, such as asphalt, sand, coal, limestone dust, residuum oil, etc., costing $2,321.88.

There was appropriated for the street repairs, asphalt plant and maintenance fund during the year, $90,000.00, of which $9,999.83 remains on hand, with one unpaid asphalt bill for Trinidad asphalt amounting to $5,811.60, which would leave a balance of $4,188.23.

The total cost of all work done, exclusive of West Michigan street, amounts to $3,301.92 for 82,968 ssuare yards, $0.642 per square yard. This includes interest on investment of $20,557.68 for six and one-half months at 5 per cent and depreciation for same period.

Deducting $12,330.72, money received for the 7,540 square yards of private work would leave the city's own repairs, including the extra concrete, cost $40,971.20 for the 75,428 square yards of actual city repairs and 4,026 square yards of concrete, or $0.543 per square yard. Deducting the cost of the extra concrete, $1,399.66, on account of not being strictly asphalt repairs, and which would have cost extra if done by contractors, would leave the actual cost to the city of its own asphalt repairs $39,571.54 for 75,426 square yards or $0.524 per square yard. This includes all expense attached to the work; superintendence, interest, depreciation on plant and tools, insurance, lease on grounds, etc.

The work was done on the same basis as other city work, eight hours per day, and was performed under the most favorable conditions, as a great many of the repairs were large and close together; only one day was lost on account of rain, and four days lost waiting on material. The builders of the plant should have some credit, as there were only seven hours lost on account of its not being ready when called upon; two hours on account of breaking a driving pinion, and five hours replacing brick work in furnace under sand dryer. This was a small loss of time, from the fact that we turned out 18,421 boxes in all.

Maltha California asphalt was used for the most part on the repair work. On account of West Michigan street being under guarantee and specifications calling for this material, Trinidad Pitch Lake asphalt was used in its re-surface. Petroleum residuum was used as a flux, and the very best of workmanship and material was used throughout.

A small force is still employed each good day during the winter to keep up the most necessary repairs. The damp weather during the fall and winter has caused the lifeless material in some of the older pavements to deteriorate rapidly and, as the mayor suggested at the beginning of work by this plant, the quality of work done by us would see the streets practically re-surfaced in a few years, as the repairs made by this department are there to stay.

SUMMARY.

SURFACE.

	Sq. yds.
Actual city's repairs	75,428
Private work	7,540
West Michigan street re-surface	9,504

BINDER.

	Sq. yds.
West Michigan street	9,504
Private work	1,767

Making a total of 103,743 square yards of surface and binder combined turned out by this plant and laid during this period; also 4,467 square yards of concrete.

Asphalt plant, roller, buildings, tools and fixtures	$20,557.68
Extra concrete	1,399.66
West Michigan street re-surface.	10,763.83
Other private work	12,330.72

Material on hand Jan. 1, 1909..	2,321.88
Balance fund on hand Jan. 1, 1909, after payment Trinidad asphalt bill	4,188.23
Cost of city repair work.....	39,133.54
	$91,133.54
Fund appropriated	$90,000.00
Six and one-half months interest on investment at 5 per cent...	566.77
Six and one-half months depreciation at 5 per cent.....	566.77
	$91,133.54

Plenty of Underground Water Near Schenectady, N. Y.

In excavating to a depth of 16 feet below the Mohawk river bottom for a lock foundation, three miles west of Schenectady, N. Y., the Pittsburg Engineering Company met with an artesian stream which filled the hole with water. Power pumps were used to pump the water out, but at no time have the contractors been able to lower it more than 4 feet. Being emptied into the river are 12,000,000 gallons of water, 2,000,000 gallons more than are pumped at the Schenectady artesian wells. The water supply of the city has not been affected. The excavation was made in connection with the construction of a movable dam and lock.

Wide Tires are Economical Road Improvers.

To the Editor of MUNICIPAL ENGINEERING:

Sir: In my letter regarding Mr. W. W. Finley's statements about road improvement, printed in MUNICIPAL ENGINEERING for January, page 40, you have it about the middle of the first column on page 41, "They are right" when I said "He (Mr. Finley) is right.

The Road Office, from whose publications I also quoted, are paying no attention to the bull in the china shop, but are contenting themselves with talking about the deterioration of the china, and how to mend it, also how to make it so strong (and expensive) that it cannot be broken so easily. Can you not get them to quit letting the people go on buying new bulls and monkeys and parrots to keep among their china?

It is all very well for the Agricultural Department to send out weather bulletins to tell the people when to come in out of the rain, but is it at all handsome treatment to leave them ignorant of the fact that they can bring in their roads with them, in so far as doing the best to correct and counteract weather influences, instead of, as now, doing everything possible to aggravate the trouble?

Absolutely we are spending more in aggravation of the road problem than in alleviation thereof; using more horsepower in making mud and dust and bad roads from otherwise good ones, than in the proper work of hauling. Why do not you jump in and wake people up on this revolutionary peace idea? Haven't we been long enough at war with our best friends, our necessary highways of communication and distribution?

True, the people may kill you as they did Bruno, for the belief that he complained of, the error that he sought to correct, did not change the face of the earth a particle, whereas the error that I seek to abate has changed the whole face of the earth with which we have to do as a people. Through a silly superstition our thoroughfares are made mud affairs, and the Office of Public Roads has pretty much nothing to say about it, while talking much about matters of slight comparative importance. J. M. HEISKELL,

Memphis, Tenn.

The Cement Industry in 1908.

Mr. Edwin C. Eckel, of the U. S. Geological Survey, has made an estimate from the data available at this time that the production of cement in the United States in 1908 was 40,000,000 barrels, a reduction of about 8,800,000 barrels from the production of 1907, or 18 per cent. There was also a falling off of imports from about 2,100,000 to about 950,000 barrels. Exports of domestic cement and re-export of foreign cements both fell off, one nearly balancing the other, so that the total consumption of Portland cement in 1908 was not far from 41,000,000 barrels, as compared with about 49,006,000 barrels in 1907.

This is the first drop in the history of the American Portland cement industry.

Unbalanced Bids on Chicago Street Repair Work.

The city of Chicago, Ill., has discovered that through the acceptance of a composite bid for street repair work, it is the loser by $96,501. The scheme by which the contract was secured by the contractors is an old one and consists of bidding high on work coming under class A and low on class B. Little work is done under the low bid and a great deal of work is done under the high bid, and the result is that when the bills come in the supposed low bidder receives far more money than would have been paid had the city divided the bids and awarded the contract to the low bidder in each class of work. In this instance the contractor bid $1.75 a square yard on class A work and 1 cent a square yard on class B work. The bills now in possession of the city call for 180,000 square yards of class A work at $1.75 or $315,000, and 11,000 square yards of class B work at 1 cent or $111, making a total of $315,111. More bills are expected to swell this total. The courts have held that as long as the work was done the city must pay according to the terms of the contract.

Amount of Pavement of Various Kinds.

The following figures will give some indication of the extension in the use of

various paving materials in recent years, although they do not include all the work done during the years named.

The General Asphalt Company has laid pavements as follows, all figures being in square yards:

	1903.	1904.	1905.	1906.	1907.
Sheet asphalt	3,628,413	2,349,395	2,743,147	3,298,104	2,402,041
Brick	219,803	273,894	4,990	19,938	19,627
Stone blocks	39,318	17,355	6,018	27,052	7,613
Bituminous macadam	15,593	1,069	31,904	15,860	8,400
Asphalt block	.....	14,075	127,536	82,960	90,381
Wood block	.....	.....	.....	.....	4,470
Miscellaneous	.....	6,878	.....	900	.....

There are numerous independent asphalt paving companies whose yardage should be added to that above stated to ascertain the total amount of asphalt pavement laid.

The members of the National Paving Brick Manufacturers' Association have laid brick pavements as follows, figures in square yards:

	1905. Approx.	1906. Approx.	1907.	1908
Ohio	675,642	1,000,000	939,247	1,937,162
Indiana	326,973	400,000	476,781	848,853
Illinois	640,198	900,000	937,000	1,350,000
Michigan	300,000	329,000	469,000	558,000
Wisconsin	149,000	200,000	219,000	416,000
Totals for states named	2,091,813	2,829,000	3,041,028	5,110,015
Other states east of Mississippi river	No rept.	No rept.	No rept.	2,670,000
Grand totals	2,091,813	2,829,000	3,041,028	7,780,015

The total amount laid in 1905 and 1906 is correct, but the distribution between the two years is estimated, and is therefore approximate. In the first five states there may be some slight increase on account of increase in membership in the association, but this is insignificant in comparison with the increase in actual yardage laid. The association covers the central states of the Mississippi valley and has few members in the eastern states, as is indicated by the states named in the table. The work of the association in unifying the efforts of the manufacturers and in advertising and promoting brick pavements and improving the specifications and inspection is bearing fruit, if one may judge from the material increase in the popularity of brick as a paving material. The same growth is indicated by the published shipments of paving brick by the largest single manufacturer, the Purington Paving Brick Company, which were 76,366,500 in 1905, 78,262,380 in 1906 and 85,321,040 in 1907.

Bitulithic pavement has been laid as follows: In 1905, 1,091,825 square yards; 1906, 1,508,093 square yards; 1907, 1,750,000 square yards.

The following tables show the amount of paving laid in two of the boroughs of New York City, also in square yards:

PAVEMENTS LAID IN BROOKLYN BOROUGH, NEW YORK CITY.

	1905.	1906.	1907.	1908.
Sheet asphalt	871,006	598,692	477,415	350,713
Asphalt block	62,709	122,292	116,039	36,086
Granite block	73,790	59,194	61,105	17,692
Belgian block	.....	.....	800	.....
Macadam	87,885	9,213	29,280	6,842
Medina stone	10,951	17,950	34,097	7,688
Wood block	4,158	.....	.....	.....
Iron slag block	.....	4,001	.....	2,311
Total all kinds	1,110,499	811,342	718,736	421,332

PAVEMENTS LAID IN RICHMOND BOROUGH, NEW YORK CITY.

Sheet asphalt	1,644	.....	.....	.....
Asphalt block	40,579	56,863	40,729	8,594
Granite block	26,513	10,977	2,164	.....
Macadam	61,812	.....	19,435	20,082
Wood block	3,472	.....	.....	.....
Iron slag block	.....	3,773	8,224	.....
Vitrified brick	15,517	.....	9,524	3,699
Bituminous concrete	.....	.....	9,810	43,523
Total all kinds	149,537	71,613	89,886	75,898

When the recent increase in the rate of growth of Richmond borough is taken into account, both these tables show a relative decrease in the amount of paving completed. This is marked in the sheet asphalt lines, but affects all except the bituminous concrete, which was introduced in 1907.

Asphalt, as shown by the General Asphalt Company's work, seems to hold its own, fluctuating from year to year about an average of a little less than 3,000,000 square yards a year. Brick shows a steady increase, which becomes much greater in 1908, beyond the end of the asphalt and bitulithic tables. Bitulithic also shows a steady gain.

We are indebted to James Lewis Rake, general agent of the Barber Asphalt Paving Co.; Will P. Blair, secretary of the National Paving Brick Manufacturers' Association; the advertisements of Warren Brothers Company; John C. Sheridan, chief engineer of highways, Brooklyn, and Theodor S. Oxholm, engineer in charge of engineering construction of Richmond borough, for the respective figures.

MUNICIPAL MATTERS IN COURT

Higher Court Decisions——Alton Water Litigation—Washington Water Power.

Decisions of the Higher Courts of Interest to Municipalities.

PREPARED BY JOSEPH W. KENNEY, ATTORNEY, INDIANAPOLIS, IND.

Construction of Viaduct — Injuries to Property Owners.—In an action of trespass against a city to recover damages for the destruction of a business caused by the construction of a viaduct and the change of grade of a street, where no negligence is alleged the plaintiff is not entitled to recover, where it appears that the plaintiff had been previously awarded damages by viewers for the injuries caused by the public improvement. (Porter v. City of Scranton, 36 Pa. Super. Ct. 218.)

Objection to Special Assessment.—The collection of a special assessment cannot be enjoined in favor of one who has had an opportunity to make his defense in the court in which the assessment proceedings were had, and his failure to make a defense there affords no ground for an application to a court of equity to relieve him from the consequences of his neglect. (Cosgrove v. City of Chicago [Ill.], 85 N. E. 599.)

Defective Grade of Street—Rights of Property Holder.—Where a city ordinance provides a particular grade for gutters, and for the crown of the pavement in grading and paving streets, unless the city engineer shall certify otherwise, and a contract is entered into by the city with a contractor in accordance with the terms of the ordinance, the contractor cannot recover the amount of an assessment bill against an abutting owner, where it appears that during the progress of the work the chief of the highway bureau changed the grade of the gutter and crown, so that when the work was finished there was no gutter on one side of the street, and the slope of the pavement was such that the abutting owner suffered a special injury in having all the surface drainage thrown on his side of the street, and there stagnating without being carried to a sewer inlet. In such a case the owner is not estopped because he did not object while the work was under way where he had no knowledge whatever that the chief engineer and surveyor had not certified to the change in the specifications of the contract; nor is the owner barred from setting up as a defense his special injury, because the work had been accepted by the city officials; nor is he barred from such a defense by act April 19, 1843, providing that on the trial of an action to recover for street improvements, it shall only be lawful to deny that the work was done or prove payment or excessive price. (City of Philadelphia v. Bilgen [Pa.], 36 Pa. Super. Ct. 562.)

Obstruction in Street — Liability. — Where one places unlawful obstructions in a street without properly guarding the same and injury results to a traveler, he cannot avoid responsibility by showing that it was the duty of a third person to remove such obstruction or to maintain warning lights. (Kenyon v. Chicago City Ry. Co. [Ill.], 85 N. E. 660.

Incorporation of City Under New Law —Effect Upon Former Charter.—The ef-

fect of the organization of the city of Chicago by its incorporation under the general law on April 23, 1875, was to substitute the general law for the city's former special charter, and to repeal all the provisions of such charter, so far as they were not consistent with the general law. (City of Chicago v. Bullis, 138 Ill. App. 297.)

Contract to Supply Water to City—Interest.—A water company furnished water to a city under a contract providing for the payment of a stated price therefor every six months. After a number of years the company claimed that the contract had expired, and presented monthly bills at a higher price, claiming an implied contract to pay what the service was worth, which bills were rejected. Held, in an action to enforce such payment, in which it was determined that the express contract was still in force, and plaintiff was allowed to recover on the express contract to avoid a second suit for the recovery of his claims; that there had been no demand of payment upon the express contract which entitled plaintiff to recover interest, it appearing that the city had been at all times ready to pay in accordance with the contract. (Appleton Water Works Co. v. City of Appleton [Wis.], 117 N. W. 816.)

City—Mode of Exercise of Powers.—Unless restrained by statute, a city has a discretion in the choice of means for exercising the choice of powers given it for governmental or public purposes. (State v. Tampa Water Works Co. [Fla.], 47 So. 358.)

Annexation of Territory to a City.—An act of the California Legislature of 1889 provides that new territory may be annexed to any incorporated town by certain proceedings. The council or legislative body of any such municipality upon petition must submit to the electors of the municipal corporation, and to the electors residing in the territory proposed by the petition to be annexed the question whether the new territory shall be annexed. Held, that the power to alter the municipal boundaries and to decide upon the shape, size and locality of annexed territory is conferred directly upon the voters of the territory to be annexed and the annexing municipality, and no authority is conferred on any legislative body or judicial tribunal to review or interfere with their action merely because of the form or extent of the territory annexed, which is purely a political and not a judicial question. The courts may interfere in such a case only where fraud was perpetrated in the matter of the boundaries or the extent of the annexed district. (People v. City of Los Angeles [Cal.], 97 P. 311.)

Assessment — Against Land and Not Owner—Notice.—A proceeding to assess damages and benefits by reason of the extension of a city street is against the land damaged or benefited and not against the owner; and a newspaper notice of such proceedings, published by order of the municipality as required by law, is a sufficient notice where it describes the land to be assessed, although it does not contain the name of the owner. (Buchanan v. MacFarland, 31 App. D. C. 6.)

Lien for Improvements — Priority to Mortgage.—A statutory municipal lien on abutting lots for sidewalk improvements, being in the nature of a government tax, may be superior to the mortgage lien on lots given after the enactment of the law creating the lien, but before the improvements were made. (Lybass v. Town of Ft. Myers [Fla.], 47 So. 346.)

Assessment by Commissioners, Basis of.—An assessment by the commissioners in eminent domain proceedings to widen a street, based largely on the value of the property, because the commissioners were of the opinion that the benefits to the property within the assessment district were in proportion to its value, is not an improper method of determining the amount of the assessment with reference to the rule that the assessment should be based on the resulting benefits. (City of Seattle v. Meteor Land Co. [Wash.], 97 P. 444.)

Construction of Ditch—Assessment—Injunction to Restrain.—Injunction properly lies to restrain payment of an assessment for and construction of a certain portion of a township ditch, notwithstanding the record shows that the trustees had jurisdiction to authorize the improvement and that all the proceedings were regular, save that the benefits thereof are denied. (Stemen v. Hizey [Ohio], 19 Dec. 155.)

Power of City to Secure Water Supply.—Authority to make provisions within lawful limitations for securing and furnishing the city and its inhabitants a supply of water is a necessary power of a municipality and may be included in powers given in general terms, where there is nothing limiting in this particular the operation of the general powers conferred. (State v. Tampa Water Works Co. [Fla.], 47 So. 358.)

Water Supply—Method at Discretion of City.—Where a city is authorized to provide for water works and to regulate any matters that may tend to promote the welfare, prosperity and morals of the city, and do all acts necessary to the general interests of the city, the method used by the city in providing water works is in the discretion of the city if no particular method is prescribed by law.—(State v. Tampa Water Works Co., 47 So. 358.)

Franchise—With Provision of City to Purchase Plant.—An ordinance granting a franchise to an electric light company, with a provision for an extension beyond the period of twenty-one years (the period limitation upon franchises of this character, Gen. St. 1901, sec. 1000), and compelling the city to purchase the plant at the expiration of such time on refusal

to extend the franchise, is contrary to law and void. (City of Clay Center v. Clay Center Light & Power Co. [Kan.], 97 P. 377.)

Change of Grade—Negligence.—A municipality is not liable to property owners for consequential damages caused by the change of a street and alley unless the work was done in a negligent manner, in which event it is liable for the injury caused by such negligence. (District of Columbia v. Atchison, 31 App. D. C. 250.)

Improvement of Street—Damages—Impassable Condition.—If a property owner during the work of changing the grade of a street and alley adjoining his house by the municipality, requests the municipal officers to remove dirt from the alley and to place it on the street, so as to make the grade of the street and alley more nearly conform and that is done, he is chargeable with notice equally with the municipality of any unseen cause of delay that may arise, not directly chargeable to the independent act of the municipality; but he does not thereby waive his right to complain of the negligence on the part of the municipality either in the manner of placing dirt on the street, or in leaving the street in an unfinished and impassable condition, unless subsequently he does some act amounting to a waiver of such negligence. (District of Columbia v. Atchison, 31 App. D. C., 250.)

Sidewalk—Difference in Levels.—Where a city builds two connecting sidewalks, one a few inches lower than the other, and joins the two by a cement apron, which has a face of 14 inches, and which at its upper edge raises the level of the higher walk 1½ inches, there is not a defect which will make the city liable for injury to a pedestrian by falling on account of the difference in levels and not because of any want of repairs, in stepping from the higher to the lower walk. (McIntyre v. City of Kalamazoo [Mich.], 117 N. W. 729.)

Alton Water Company's Litigation.

The United States Supreme Court handed down an opinion January 11 at Washington, D. C., denying the petition of James Hamilton Lewis, of Chicago, for a writ of certiorari in his suit against the Alton Water Company, of Alton, Ill.

Associated with Mr. Lewis as petitioners were a number of bondholders, suing under a trust deed of the Boston Water and Light Company to the International Trust Company.

The brief cited that the facts of the case begin with a mortgage executed in 1897 by the Alton Water Works Company to the Farmers' Loan and Trust Company on its water plant and franchises in the city of Alton. The mortgage contained a provision extending the same to all existing property and franchises, as well as to those it might thereafter acquire. In 1893 the New England Water Works Company bought out the Alton Water Works Company. In 1898 the Boston Water and Light Company appeared in the village of upper Alton and was granted exclusive privileges. By the issue of 200 first mortgage bonds in the sum of $1,000 each, money was raised and secured by a deed of trust to the International Trust Company. The petitioners associated with Mr. Lewis secured $125,000 worth of their bonds. A foreclosure of the mortgage formerly assumed by the Farmers' Loan and Trust Company on the property of the Alton Water Works Company was made to involve the property of the Boston Water and Light Company on the theory that it came within an after acquired property clause.

Various suits were brought by the petitioners, but they were denied judgment on the ground that they had not been the original parties, and for the disobedience of one of the court decrees which prevented the entering of a suit and the disregard of certain foreclosure proceedings, Mr. Lewis, as one of counsel, was cited for contempt, and upon being found guilty was sentenced to serve a term of sixty days in the county jail of Sangamon county, Illinois.

Pleading that their case was appealable to the United States Supreme Court, a writ of certiorari was asked for there. The court's denial of the petition January 11 makes the bondholders liable for their part of the foreclosed mortgage.

Judge Humphrey refused the temporary restraining order asked for by the Alton Water Company, but the court of appeals held, January 17, that the court erred and sent the case back for rehearing. Judge Humphrey has granted the temporary order.

Water Power Case in Washington.

A decision was handed down by Judge Mitchell Gilliam of the Superior Court at Seattle, Wash., recently, declaring in effect that the Pacific Coast Power Company, which is engaged in the construction of an immense electric power plant on White river, has established its right to condemn lands aonig the river by showing that the waters of the stream were to be devoted to public use. The court's ruling came after the attorneys representing fifty land owners along the stream had asked for a dismissal of the suit on the ground that the plaintiff corporation had not shown that its purposes were of a character falling within the operation of the eminent domain law.

The power company will now vigorously push the condemnation suits, and the claims of the property owners along White river, as fixed by the trial juries, will be speedily settled. The present plan is to develop approximately 50,000 horsepower. Engineers have reported, however, that ultimately the plant can be developed so as to attain 100,000 horsepower.

MUNICIPAL AND TECHNICAL LITERATURE

Birmingham Public Works—Washington Street Lighting—Municipal Reports

Birmingham, Ala., Public Works.

The annual report of City Engineer Nicholson for 1908 shows the smallest amount of public improvements done in Birmingham, Ala., since 1894. During the year $101,113 has been expended on paving; $7,218 on sewers; $13,541 on sidewalk and gutter improvements; $100,000 for repairs and improvements with chert.

This decrease in municipal improvements is ascribed to three causes: First, the year of 1908, starting in with the panic in full blast, the municipal authorities were loath to add further burden to the taxpayers of the city; second, the city had become involved in so much litigation, as the result of defective laws passed by the legislature, that the council deemed it best to take no chances of making improvements which would be repudiated by the property owners, as they were in the Norwood case; third, and perhaps the most important, was the fact that very little competition could be secured in the matter of making bids.

When Julian Kendrick was city engineer he and City Attorney Smith were puzzled as to whether or not there was some way by which the city could advertise for bids for street paving without specifying the kind of pavement to be used. Up to this time it had been the habit, and was regarded as the law, that the kind of pavement must be specified when advertising for bids or drawing improvement ordinances. Messrs. Kendrick and Smith thought the citizens should have the benefit of competition, and to remedy the situation a bill was introduced into the legislature. The matter is now up for a test case. A small piece of property belonging to the Birmingham Realty Company has been drawn into an improvement ordinance without the kind of a pavement being specified. Different contractors bid on different kinds of pavement, leaving the owner to select the one that suits best and the cheapest of its kind. Many contractors submitted bids and all are under the old bids formerly received. Should this ordinance prove legal, the city will, during 1909, lay more pavement than it has ever before laid.

Washington, D. C., Street Lighting.

A special report on the improvement of the street lighting system of the chief business and residential sections of the city of Washington, D. C., was submitted to the District Commissioners December 26 by Walter C. Allen, District electrical engineer. Mr. Allen says the lighting of the streets in the city portions of the District has remained about the same for the last ten years, because of the necessity of extending the lighting system to the rapidly growing county portions. He says:

In the eleven years from July 1, 1897, to June 30, 1908, the several street lighting systems have been extended by the addition of 7,568 lamps, of which 4,757, or over 62 per cent, have been erected in that portion of the District outside of the city limits. The following table shows the distribution of the several kinds of lamps throughout the District added during the above-mentioned period:

LAMPS ADDED — JULY 1, 1907, TO JUNE 30, 1906.

Kind of Lamps.	Inside City Limits. N.W.	N.E.	S.W.	S.E.	Outside.	*Pct.T'l.*	*T'ls.*
Gas	552	259	99	280	1,653	58	2,843
Naphtha	134	230	202	169	1,249	63	1,984
Electric incandescent	189	89	12	...	1,673	85	1,963
Electric arc	364	115	52	75	172	22	778
Totals	1,239	693	365	524	4,747	62	7,568

The opening of the new streets and the erection of numerous houses in them outside of the city limits required these extensions. At the same time the most traveled of the suburban roads have been lighted, all main thoroughfares having the lights extending to the District line.

Where gas lamps were erected the practice has been to place the posts as near as possible, 125 feet apart, that distance having been found to give good results for residence streets. As that is closer together than the lamps are placed in the older portion of the city, it gives to those gas-lighted streets a better lighting system than the city proper.

The report contains a number of recommendations and suggestions, including the half-night plan, and poles in the middle of Pennsylvania avenue, commonly known as "aisles of safety."

Municipal Reports.

First Annual Report of the Department of Engineering of Hartford, Conn. Frederick L. Ford, City Engineer. 1908.

This report covers the first year of operation of the new city department of engineering in Hartford, created by an amendment to the city charter passed in March, 1907. Under this law the city engineer is appointed by the mayor, with the approval of the aldermen, to serve "during good behavior or until removed for cause," and it is made his duty to perform all the engineering service for all the boards and departments of the city and superintend the construction of all public works not specifically assigned to other officials. All his employes are appointed and removed by him, and he fixes the salaries of all employes which do not exceed $100 a month.

Following the adoption of the law the council fixed the city engineer's salary at $5,000 a year and gave him five assistants at salaries from $2,280 to $1,320 a year. F. L. Ford, who has been city engineer for some years, was appointed to the new office under the old name. The office has eight employes with salaries of $100 or less. It uses numerous high school boys and college students during the summer at nominal salaries.

The abolition of the Albany avenue grade crossing has been completed, and that of Walnut street will be completed next year. A study of a general plan for grade crossing removal is under way.

The marking of the street lines with stone monuments is under way, and about 180 stones were set during the year.

Sewers costing $145,000 were built during the year, most of them small, but including four concrete sewers of 3 to 10 feet diameters.

The cost of street sprinkling seems to reduce as the mileage increases. Thus, in 1899, it cost $470.73 a mile to sprinkle 44.37 miles of street, and it cost $354.11 a mile to sprinkle 54.57 miles in 1907. The figures for the years between roughly follow the same proportion.

Mr. Ford is also one of the principal workers in the Municipal Art Association of Hartford, which has made some thorough studies of the problems connected with the improvement in conditions and appearance of the city, and is meeting with some success in its efforts toward putting its ideas into practical construction.

New Publications.

Methods and Devices for Bacterial Treatment of Sewage. By William Mayo Venable, M. S., M. Am. Soc. C. E., M. Am. Inst. Elec. Engrs. 236 pp. Cloth, $3. John Wiley & Sons, New York.

Mr. Venable has compiled and written a book which is of much interest, and should prove of considerable value to the engineer who designs or operates sewage disposal plants of small size, with which the experience detailed in the book shows that the author is familiar.

In the introductory chapters the office of the various parts of a sewage disposal plant, with reference to the encouragement and discouragement of bacterial action, and the sources of information about sewage purification in books and engineering periodicals, are briefly stated. Then follow chapters on the aerobic treatment of crude sewage, the mechanical removal of sludge, the anaerobic treatment of sewage, intermittent contact systems, automatic discharging devices and percolating filters. Much space in these chapters is used in giving the principal features of the numerous patents upon processes and apparatus in all these lines, and this makes this part of the book particularly valuable, because it is a full statement by an intelligent and expert observer of their principles, and, to a certain extent, of their successes and failures.

A summary of engineering principles involved in the design of sewage purification works is given in one chapter, which is quite full and reasonably satisfactory.

The later chapters are devoted to the details of difficulties experienced in some actual installations and are practically documentary histories of the author's connection with certain installations of sewage purification plants in institutions belonging to the U. S. government. While the same difficulties may not occur in the same way in any other plant, many hints can be gathered from the descriptions of failures and of the methods used to turn them into successes, complete or partial. While there is a preponderance of instruction as to how not to do it in the chapter, there is a liberal amount of positive information. The last chapter gives some suggestions as to designs to meet typical conditions.

As stated above, the engineer will find the book of value, although its practical applications are largely on the negative side, and it details no pronounced successes in sewage purification plants, leaves him much in doubt as to the probability of the success of the designs and the apparatus presented, and gives him little that he can copy directly or can use in developing his own designs. This is in one sense fortunate, for there are too many engineers who look for the design nearest what they want, and then modify it slightly to suit their own purposes. The last chapter can be used for such purposes, but it carries the doubts expressed above. These doubts are, of course, due to the present state of progress in the art of sewage purification, and are not due to the state of mind of the author so much as to the state of mind of the engineering profession, which he faithfully reflects.

House sewage, concentrated in one case and diluted in another, is the only waste shown in the descriptions of actual installations, but this is what nearly all small plants have to deal with.

ORGANIZATIONS AND INDIVIDUALS

National Association of Cement Users—Michigan Engineering Society—Montana Engineering Work—Chicago Cement Show—Technical Meetings—Civil Service Examinations—Personal Notes.

National Association of Cement Users.

Notwithstanding three extra sessions and meetings in separate sections, the program for the Cleveland convention of the National Association of Concrete Users could not be completed. Part of it seems to have been printed without due consultation with the prospective authors of papers. The mass of data and discussion presented was very valuable, and, taken as a whole, is an excellent epitome of the status of cement and concrete at this date. The paper by Mr. Wason, given elsewhere in this number of MUNICIPAL ENGINEERING, was one of the most practical papers presented and gave rise to much discussion. The value of methods of cost keeping to the firm using them was clearly shown, and the danger in applying the results obtained by one firm in close estimates of work to be done by another not having the full knowledge derived only by personal knowledge of the work, was also emphasized in the discussion. Other papers on cost data and methods of obtaining them also showed the influence of local conditions upon results.

The registration at the convention did not vary much from the usual number, and there was the usual attendance at the exhibition of many who did not join the association and who did not even attend its meetings. This condition is due to two facts—one, the commercial nature of the exhibition and the attraction of men who come to do business and to see what others are doing and do not care for the instruction and discussion in the convention sessions, and the other, the elevation of the convention proceedings so far above the heads of the audiences that their interest could not be held. This does not, of course, interfere with the intense interest of those who come because of their desire to learn what others are doing. This was quite as strong as ever, and is one of the most encouraging features of the conventions.

There were the complaints about the business management of the convention to which attendants have become accustomed during the past three or four years, but the printed registry was a material improvement over those of recent years. Registers kept by exhibitors show very different lists of names from those kept by the secretary, and show still more clearly the lack of correlation between the convention and the exhibition. The attempts to get away from the earlier ideas of the association are so strong, and the inability of many to follow the lead of the present officials, suggests that the business features be made less prominent, and be left rather to those, like the managers of the Chicago show, who have shown their ability to handle the problem successfully; that the rank and file of cement users among the attendants be referred to the various local associations, which more nearly suit their needs than the increasingly difficult programs arranged for this society; and that if the present desires of the permanent officers of the association are to be permanent also, the membership be allowed to limit itself to those in sympathy with these high and most commendable ideals. The developments of the past two years in the cement field should make such procedure easy, and, in fact, seem to be making it each year more necessary. There is room for all and for still more, and the highest efficiency of all the agencies working for improvement in the cement and concrete field seems to demand some such differentiation.

Michigan Engineering Society.

The Michigan Engineering Society had a very successful meeting in the new engineering building of the University of Michigan at Ann Arbor, January 12 to 15. In addition to the committee reports there were papers as follows:

"The Fort Hall Irrigation Project," by John J. Granville, Ross Fork, Idaho.

"Land Surveying" in California by Geo. E. Steele, Turlock, Cal., and in Michigan by W. H. Goss, Bangor.

"Errors in Platting," by Prof. H. K. Vedder, East Lansing.

"Needed Drainage Legislation," by J. W. Harrod, Ithaca.

"Street Railroad Fares," by Prof. M. E. Cooley, showing that a 3-cent fare is impossible.

"Sewer Gaugings," by Delmar E. Teed, Cadillac, reproduced elsewhere in this number.

"Freaks in Concrete," by W. W. Bugden, Battle Creek, also reproduced in MUNICIPAL ENGINEERING.

"Recent Developments in Electric Lighting," by Prof. G. W. Patterson, Ann Arbor, with special reference to the new tungsten lamp.

"The Solar Compass," by H. E. Bent, Waterloo, Iowa, the inventor.

"The Grand-Saginaw Deep Water Way," by John F. Nellist, Grand Rapids.

"Flood Protection at Grand Rapids," by L. W. Anderson, city engineer.

"Testing Ship Models," by Prof. H. C. Sadler, with demonstrations in the testing tank of the university.

"The Modern Gas Engine," by Prof. John R. Allen.

"Gas Engines and Suction Gas Producers" (bituminous coal), by N. W. Harrington, Lansing.

In the discussion on concrete, Benj. Douglass of the Detroit river tunnel brought out some interesting results of experiments showing the effect of clay in making concrete water-proof.

An abstract of the address of the president, State Geologist Alfred C. Lane, on "The Engineer and the State," will be presented next month.

Montana Engineering Work.

Through the courtesy of H. C. Allen, city engineer of Glasgow, Mont., a copy of the address of President A. E. Wheeler to the Montana Society of Engineers at Great Falls on January 9 has been received. The address reviews the engineering work of the State and is a most remarkable showing in amount and character of work done and in progress.

The U. S. Reclamation Service has four projects completed or in progress; the Huntley, 29,000 acres, completed; Lower Yellowstone, 66,000 acres, 80 per cent completed; Milk River, 100,000 acres, and Sun River, 276,000 acres.

The Chicago, Milwaukee & St. Paul railroad is building its new through line, and the Northern Pacific, Great Northern, and Billings & Northern are doing much improvement work and changes and extensions of lines.

The water power projects under way include the Madison River Power Company, now developed to 15,000 horsepower and still growing; the Helena Power Transmission Co., rebuilding the Hauser Lake dam and building the Wolf Creek dam to develop 70,000 horsepower, and the Great Falls Water Power and Townsite Co., which is developing some of the great water powers at that city.

Much of the paper is devoted to the phenomenal developments in mining, in which Mr. Wheeler is most directly interested as the superintendent of the Boston & Montana smelter.

The new officers of the society are Chas. H. Bowman, Butte, president; Frank M. Smith, Helena, and F. W. C. Whyte, Anaconda, vice-presidents; Clinton H. Moore, Butte, secretary and librarian; Samuel Barker, Jr., treasurer; Theodore Simons, Butte, trustee.

The Chicago Cement Show.

As announced elsewhere in this number of MUNICIPAL ENGINEERING, the great cement show of the year will be held in Chicago at the Coliseum, February 18 to 24, inclusive. Practically all of the space on the main floor and a good share of the space in the balcony was taken a month before the opening. The Exhibition Company takes care of all decorations, signs and furniture of general description for all the exhibits, and a material improvement in the general appearance and convenience of the show is confidently expected. MUNICIPAL ENGINEERING will be there and will welcome old friends and new to its office. The new edition of the Directory of American Cement Industries is in preparation and every visitor should register name and business for inclusion in it.

Return tickets at half-fare can be obtained if a thousand presons pay full fare to the show and get the regular certificates from ticket agents of whom tickets are bought. This applies to all States from Western Pennsylvania and New York to Montana, Colorado and Arizona, except those south of the Ohio river, Arkansas, Oklahoma and Texas. Those coming from the Eastern Canadian Passenger Association territory are included. Those from Western Passenger Association and Southwestern Excursion Bureau territory; that is, west of the Mississippi river, should get certificates to the Merchants Meeting of the Chicago Association of Commerce.

Proposed Municipal Ownership of Lighting Plants for Washington, D. C.

A bill authorizing the acquisition of all plants of electric lighting companies and gas companies in the District of Columbia, by purchase or condemnation, was introduced in the House, January 14, by Representative Jenkins of Wisconsin, chairman of the House committee on the judiciary. The bill authorizes the District commissioners to acquire the plants and property in question, and for the purpose of ascertaining the cost and value of the plants the President is authorized to appoint, with the consent of the Senate, one engineer officer of the army and two citizens of the District to agree with the owners of the plants as to the price. The commissioners and three persons indicated are constituted a commission for the purchase of the plants, and the assistant to the engineer commissioner of the District, in charge of public highways, is named to act as executive officer of the commission. The commission is directed to make an accurate map of the properties, showing the location, quantity and character of each of the plants and all of the property necessary to their proper op-

eration, with the names of the respective owners attached, the whole to be recorded in the public records of the District.

If an agreement can be reached with the owners of the property as to a satisfactory price, the commission is authorized to make the purchase, and a sum sufficient to carry out the plans of this provision is appropriated by the bill. If the commission shall be unable by agreement with the respective owners to purchase the plants or any one of them, provision is made that the plants shall be condemned and the title vested in the United States, after just compensation. The attorney-general is directed, in such a case, to make application to the Supreme Court of the District for an assessment of the value of the plant that the commission could not purchase.

Technical Meetings.

The National Brick Manufacturers' Association will hold its annual convention at Rochester, N. Y., February 1, 2, 3, 4, 5 and 6. T. A. Randall, secretary, Indianapolis, Ind.

The annual meeting of the Connecticut Society of Civil Engineers will be held at Hartford, Conn., February 9. J. Frederick Jackson, secretary, Box 1304, New Haven, Conn.

The next annual meeting of the New England Gas Association will be held at Boston, Mass., February 17 and 18. N. W. Gifford, secretary, East Boston Gas Co., East Boston, Mass.

The third annual convention of the Interstate Cement Tile Manufacturers' Association will be held at Minneapolis, Minn., March 2, in conjunction with the annual convention of the Northwestern Cement Products Association.

At the annual convention of the Iowa Engineering Society, held at Waterloo, Iowa, January 13 and 14, officers for the ensuing year were elected as follows: President, C. T. Wilson, Waterloo; vice-president, T. F. Warriner, Cedar Rapids; secretary and treasurer, A. H. Ford, Iowa City; directors, L. H. Stone, Cedar Rapids, and C. P. Chase, Clinton.

At the annual meeting of the Illuminating Engineering Society, held in New York City January 8, officers were elected as follows: President, W. H. Gartley, Philadelphia; vice-presidents, C. O. Bond, Philadelphia, J. S. Codman, Boston, and G. C. Keech, Chicago; secretary, P. S. Millar, New York City; treasurer, A. H. Elliott, New York City; directors, A. S. McAlister, New York City, E. N. Wrightington, Boston, and George R. Green, Philadelphia.

At the regular meeting of the Brooklyn Engineers' Club, Brooklyn, N. Y., January 14, Arthur I. Perry, assistant engineer of the Department of Bridges of New York City, read a paper on "The Manhattan Bridge Cables."

The Independent Asphalt Association held its annual meeting in Washington, January 19. The principal address, by A. L. Barber, proposed for country roads a macadam highway with a strip of asphalt pavement running through, usually in the middle. He thinks the horses could use the macadam as at present and automobiles could use the asphalt, slowing down and turning onto the macadam to pass each other. He estimates the cost of a 16-foot macadam road at $10,000 a mile, and with a 6-foot strip of asphalt in the middle at $13,000 a mile.

The Indiana Engineering Society held one of its most successful conventions January 14, 15 and 16. Over 125 members of the society and of the Indiana Sanitary and Water Supply Association attended the banquet, which was addressed by R. C. McCormick, president of the Chicago Drainage Commission; Henry Riesenberg of the National Waterways Association and members of the two societies. The engineering profession in Indiana is interested in a number of projects before the Legislature, and the society expressed itself strongly upon the subjects of prevention of stream pollution, public service and highway commissions, uniform public accounting, improvement of the county engineering work, etc., and the first two were specially well treated in the papers and committee reports presented. E. E. Watts, Princeton, was elected president and Chas. Brossmann, Indianapolis, secretary.

The National Tariff Commission Convention will meet in Indianapolis, Ind., February 16, 17 and 18.

The Carriage Builders' National Association and the National Grange, Patrons of Husbandry, are making strong efforts to increase the interest in the cause of good roads.

The Iowa Association of Cement Users holds its convention at Des Moines Feb. 2, 3 and 4 in the Savery Hotel. A half day will be given to a trip about the city and to the new cement plant. The exhibit will be held in the Crugan building, where there is about 10,000 square feet of available space.

The fifth annual convention of the Northwestern Cement Products Association will be held in Minneapolis, Minn., March 2, 3 and 4.

At the meeting of the Brooklyn Engineers' Club, Jan. 14, Arthur I. Perry presented a paper on the Manhattan Bridge cables, illustrated by stereopticon. Joseph Strachan, secretary.

The Interstate Cement Tile Manufacturers' Association will hold its third annual convention at the Armory, Minneapolis, Minn., March 2. A large attendance is expected, as the work of this association is rapidly growing more important to its members.

At the annual meeting of the New England Water Works Association, held in Boston, Jan. 13, Bertram Brewer gave an

informal illustrated description of the water works of Havana, Cuba, and there were reports from the committees on legislation, standard specification for fire hydrants, awards for water-diversion damages, depth of water pipes, and water works valuation awards. Willard Kent, secretary, Narragansett Pier, R. I.

The fourth annual convention of the Nebraska Cement Users' Association, to be held at Lincoln Feb. 10, 11, 12 and 13, promises to be its largest and most successful meeting. The exhibition will be held in the Auditorium and the convention in the Lindell Hotel. J. E. Watenpaugh, of Western, Neb., is secretary and will send full information if addressed before the convention at the convention hotel in Lincoln. L. E. Porter, of York, president, will also be there until the convention adjourns.

Civil Service Examinations.

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

Feb. 3: Engineer in the Reclamation Service at $175 to $350 a month.

Feb. 3, 4: Superintendent of construction of public buildings, Supervising Architect's Office, Treasury Department, at $1,600 to $2,500 a year.

Feb. 17: Engineer competent to take care of pumping plant, tank house, etc., in Indian Service at Ft. Berthold, N. Dak., at $720 a year, and similar vacancies at $480 to $1,000 a year.

Feb. 24, 25: Topographic aid in Geological Survey at $840 to $1,200 a year.

Personal Notes.

J. M. Moore has been elected mayor at Villa Rica, Ga.

J. W. Barnett has been elected city engineer at Athens, Ga.

C. C. Ward has been appointed city engineer at Wenatchee, Wash.

R. H. Thomson has been reappointed city engineer at Seattle, Wash.

A. A. Averett has been appointed second assistant city engineer at Charleston, S. C.

Marcellus Strickland has been appointed county engineer of Chester county, Pa.

Walter W. Cleary has been re-elected president of the board of council at Covington, Ky.

Frederick C. Stevens has been reappointed superintendent of public works for the State of New York.

William C. Ambrose, M. Am. Soc. C. E., died at his home in Berkeley, Cal., January 4, at the age of 51 years.

Winslow L. Webber has been re-elected city engineer for the twenty-first consecutive year at Gloucester, Mass.

William H. Lawton, M. Am. Soc. C. E., has been appointed city engineer for the fifth term at Newport, R. I.

Fred H. Stiles, street commissioner at Oswego, N. Y., has been appointed superintendent of the Oswego Water Works Co.

Frank G. Lake has been elected president and William J. Davis vice-president of the board of water commissioners at Atlanta, Ga.

W. M. Wilson, formerly city engineer at Gadsden, Ala., has been appointed assistant engineer of the board of public works at Mobile, Ala.

Edward Nieson addressed the Scientific Academy of St. Xavier's College at Cincinnati, O., recently on "Filtration as a Method of Water Purification."

William B. Vetterlin, C. E., formerly on the staff of the city engineer and for a number of years with large New York contracting firms, died January 17.

Claire M. Belding, assistant city engineer at Cleveland, O., in charge of harbor, wharf and river improvements, has resigned to take charge of canal repair work being done by the State.

Walter S. Bissell has been elected treasurer of the F. Bissell Company, of Toledo, O. Mr. Bissell has been associated with this company for a number of years as traveling salesman.

Frank C. Osborn, M. Am. Soc. C. E., president of the Osborn Engineering Company, Cleveland, O., has been appointed a member of the Cuyagoga County Court House Commission.

Hon. John S. Taylor, who was serving his fifth term as mayor of Sheridan, Wyo., was found frozen to death a mile north of town, December 26. Mayor Taylor was 38 years of age.

A. B. McDaniel and C. A. Trimmer have established offices in Vermillion, S. D., under the firm name of McDaniel & Trimmer, for the practice of civil engineering and architecture.

Timothy Woodruff, who has been superintendent of the water works at Bridgeton, N. J., since their construction in 1877, has been appointed commissioner of public works of that city.

W. H. V. Reimer, who has been city engineer at East Orange, N. J., since 1895, has retired, and will probably be succeeded by his son, Frederic A. Reimer, now assistant city engineer.

William Solotaroff, secretary and superintendent of the Shade Tree Commission of East Orange, N. J., has a number of lectures on trees and their care which he delivers to interested organizations.

Charles E. Perkins, of Akron, O., has been reappointed chief engineer of the Ohio State Board of Public Works, and J. C. Wonders, of Bellefontaine, has been reappointed State highway commissioner.

Frank D. Lyon, of Binghamton, N. Y., has been appointed special examiner of highways, to serve until the new State highway commission, to be appointed by Governor Hughes of New York, formally assumes office.

Major Edward Owen, commander of the New York Camp of Confederate Veterans, for many years commissioner of accounts of the city of New York, has associated himself with Henry W. Brooks, Jr., & Co., public accountants.

Frank L. Getman has been appointed to take charge of the construction of part of the sewerage system at Havana, Cuba. Mr. Getman retired at the end of the year as deputy State engineer and surveyor of the State of New York.

Foster Crowell, M. Am. Soc. C. E., has resigned as commissioner of street cleaning in New York City. He will be succeeded by William H. Edwards, who was appointed deputy commissioner under Commissioner Craven in March, 1907, and became acting commissioner shortly afterwards during Mr. Craven's illness.

Walter E. Spear, Assoc. M. Am. Soc. C. E., has been appointed chief engineer of the Brooklyn branch of the department of water supply, gas and electricity of the city of New York. John E. McKay, M. Am. Soc. C. E., who has served as acting chief engineer of the Brooklyn branch for two years, has been transferred to Staten Island as assistant engineer.

MACHINERY AND TRADE

A Prosperous Pipe Foundry.

Following the announcement of the Lynchburg Foundry Co., Lynchburg, Va., of improvements to their Radford (Va.) pipe plant, as noted in our January issue, this concern has just announced the purchase of a large tract of land at Norfolk, Va., with deep water frontage and belt line railway connections, on which they will build a large modern pipe foundry for export and coastwise trade.

Mr. H. E. McWane, the president of the company, together with his brother, J. R. McWane, vice-president and general manager of the American Cast Iron Pipe Co., Birmingham, Ala., sailed January 6 for an extended tour of England, Belgium, Germany and France, to visit pipe foundries in those countries, before making plans for the new plant.

The growth of the Lynchburg Co., whose pipe department is operated under the name of the McWane Pipe Works, has probably been unequalled by any similar concern in the history of this country of marvelous industrial progress. Starting in 1903 with an annual capacity of 4,500 tons of small sizes of cast iron pipe, this tonnage has been gradually and rapidly increased to an output of more than 45,000 tons in 1908, and the new plant, it is stated, will start with an additional capacity of 25,000 tons per annum. Their product is well and favorably known from Maine to California, and this large increase in tonnage has, it is apparent, not been made at the expense of quality.

Engineering Instruments of Note.

We are in receipt of the new catalog of engineering instruments issued by the Bausch & Lomb Optical Co., Rochester, N. Y., of which Mr. Geo. N. Saegmuller is a member. Aside from its copious illustrations, this publication is of interest because of the complete specifications given for the optical and mechanical construction of the various transits, levels and theodolites. The several unique features of the Bausch & Lomb instruments are explained in a brief manner and an entirely original mining transit is cataloged for the first time. The distinguishing features of this new instrument include a prismatic side telescope which is novel in construction and which we will describe more fully at a later date. With this instrument the U standard construction, together with a compass circle of the usual form, is introduced. We recommend this interesting publication to our engineering friends. It is sent gratis upon request.

Increased Capacity of Marquette Cement Manufacturing Company.

Announcement of the addition of machinery and equipment which will increase the total investment to more than $2,000,000 is made by the Marquette Cement Manufacturing Co., of Chicago. The works of the concern are at La Salle, Ill.

The improvements will increase the output 50 per cent over that of last year, bringing the total to 6,000 barrels of Portland cement daily. The company's works already are the largest in Illinois. They were started twelve years ago with an output of 500 barrels a day.

The concern is controlled and directed by William and Theodore Dickinson, of Chicago, pioneers in the cement industry. The increased output is provided for because of the anticipation of increased consumption of cement, everything indicating a return of prosperity to this branch of the building trade, as cement now is being used largely in every building project.

Detroit's New Asphalt Paving Plant.

The accompanying cut shows the municipal asphalt paving plant installed last summer by the F. D. Cummer & Son Co., of Cleveland, O., for the city of Detroit. It has an easy capacity for turning out 1,500 square yards of 2-inch top per day of ten hours.

The melted asphalt is delivered from open kettles, located in another plant adjoining, into a closed, mechanically agitated kettle of 15 tons capacity. From this kettle the asphalt is forced by air pressure to the mixing platform, where it is delivered into an asphalt bucket as wanted, and dumped into an enclosed mixer.

The sand is dried and heated in a Cummer patent drum. This machine consists of a revolving cylinder of special design. It supplies all the heated sand desired. The manufacturers advise us that this drum is their medium size, as they build three sizes larger and three sizes smaller.

The heated sand is elevated from the drum to a storage bin over the mixer, which holds sufficient sand for fourteen dumps. In connection with the sand storage bin is a diamond sand box for measuring the sand into the mixer. Over the

sand bin is a revolving screen for separating all pebbles and foreign matter from the sand before it is delivered into the bin.

Mr. C. A. Proctor, who is in charge, is much pleased with the Cummer plant and will be pleased to show it to any one wishing to inspect it.

A Conveyor for Paving Brick Laying.

Considerable economy is accomplished in paving by the use of the automatic brick conveyor, which makes a great saving of labor and time and delivers the brick to the paver unchipped or broken. This brick handling device, which is the property of Carlson & Theselius, does away with the wheel barrow to an extent, and some of the men necessary to operate that ancient vehicle. The brick are brought from the wagon or pile direct to the paver where he is placing them in the pavement. The man who feeds the carrier does not labor so hard as the man at the wheelbarrow and turns out several times the amount of work he could do with it. Gravity does most of the work. Like all modern improvements the device is very simple, easy to operate and not expensive. It is portable and is placed in position in a moment. The machine is made in various lengths, but a man can carry one used for ordinary purposes. It is almost entirely made of wood.

In form the brick conveyor is a chute, but its bottom consists of rollers. These rollers are transversely journaled in close proximity to each other, and work with the least friction on pivots or axes. The spools or rollers are in the bottom of the apparatus, but the sides of the machine do not project much above them. The chute is thus rather shallow, while the width is adjusted to the thickness of a brick.

To use it in transmitting brick one end of the apparatus is adjusted on the wagon or pile of brick. The other end is placed in the bedding in front of the paver. The chute thus arranged forms an incline from the source of brick supply to the paving area. The bottom of the trough consisting of a series of parallel rollers, a brick placed at the upper end moves down towards the mason on the street.

One unskilled man is all that is necessary to handle the brick at the source. He places brick after brick at the upper end of the incline, which descend to their destination without any further work on the part of the laborer. The bricks move in a continuous chain downward, and the mason catches them quickly, two at a time, before they reach the lower end. The comparative rapidity with which they come downward, keeps the paver working without cessation.

The apparatus is always in front of the operator. Ample space for comfortable operation is left between the newly paved area and the machine in front of the ma-

THE CUMMER ASPHALT PAVING PLANT AT DETROIT, MICH.

son. Not to be in his own way, the operator stands, of course, on the part of the street already covered. The conveyor is pushed away from the man as soon as two or three courses of brick have been laid and more room is required for paving.

As the device is not heavy, to move it is no effort. The barrows used ordinarily distribute the brick in little piles on the bedding for the mason. This device distributes the material uniformly. The piles of brick dumped from the wheel barrows are often in the way or out of convenient reach of the man using them. The chute device distributes the material of the paver with greater uniformity and always within convenient reach of the operating device. As in dumping brick, some of them must, of necessity, become chipped and even cracked, an inconvenience is entailed which is avoided in the automatic handling of brick where they move down the series of rollers of the chute without striking against each other or any hard surface that would damage them. The bricks, where this machine is to be used, are usually distributed along the sidewalk. But the chute may be fed direct from the wagons or from wheelbarrows. The latter is most often convenient, as it is necessary often to pile up the brick in some vacant lot or in big piles on the sidewalk. When the source of supply is left far behind the operator, it becomes necessary to convey it in barrows to the chutes. They often use chutes on both sides of the street at the same time.

The handling of brick in this manner is so convenient that paving proceeds very rapidly. It is estimated that seven men—four laborers and three pavers—can cover 2,500 yards a day on a prepared grade. Carlson & Theselius, 912 Granville avenue, Chicago, the owners of the automatic device, state that they have used it successfully for several years. They have paved streets in seevral parts of the country. This summer they say they paved 200,000 yards of streets and alleys in Chicago and its suburbs alone. The cost of work is so much cheaper that they can underbid the leading contractors and still have a better margin for profit. They will exploit the machine chiefly in their own work, but will also rent it to other contractors.

The device is of particular interest to municipalities.

An Improved Form for Paving Brick.

In the early days of paving brick the process of manufacture was similar to that for ordinary brick and the edges and corners of the brick were sharp and square. After the wire cutting machine was introduced they were preferably wire cut. In those days the foundations of brick pavements were not good and the joint fillers were more experimental than at present. As a consequence the first effect of wear was to round off the edges and corners of the bricks. Well-shaped bricks would lie close together unless special precautions were taken to keep them apart, and it would be difficult to get the filler into place. These considerations and some others, such as a fancied consolidation of a brick by pressure, led to the introduction of the repressed blocks and bricks, with the development of rounded corners, grooves or lugs on the flat sides to give space for the filler to run in, and the like, and at this time most of the good bricks on the market are repressed.

But the rounded corners run contrary to the constant effort to make the wearing surface of the pavement smooth, and we have developed methods of filling the joints which perfectly protect the edges, and make the surface continuous, even with the rounded edges of the repressed brick. Practically, therefore, as well as theoretically, the wire cut brick is, under present conditions, in better form for making the smooth surface, which is now demanded, than the repressed brick. Many engineers and paving contractors have always held this, and some that this is more important than the other advantages claimed for the repressed brick. All admit the great desirability of lugs to make brick-laying with uniform width of joints in straight lines simple, easy and rapid, and the application of filler easy and complete. These lugs can now be put on a wire cut brick in the process of cutting.

That the consolidation of the brick is more fancied than real is shown by the statement published in December, 1907, by a prominent paving brick manufacturer, that when a wire cut brick was put through a repressing machine it gained 3.5 cubic inches in volume. A study of what happens in the mold shows why this happens. The mold must be from one-eighth to three-sixteenths inch longer and wider than the wire-cut brick so that the drop into it shall be free, even if there is a slight variation in size of the brick on account of variations in the consistency of the clay column. When the plunger descends into the mold and presses on the broad side of the brick it breaks up and spreads the clay enough to fill the mold out full and also the letters on the pressing plate, if there is clay enough present. We know that clay does not flow easily and when dry not at all under pressure, so that there are enough voids and unpressed sections to prevent the clay rearranging itself in the equivalent of its original volume produced by cutting the bricks off of the ribbon of clay forced by the auger through the die with such pressure and motion as to produce very near the maximum of density. With the edges protected from injury the wire-cut brick should be and is more durable than the repressed brick of the same material. Much oil is used in the repressing process and it penetrates the clay

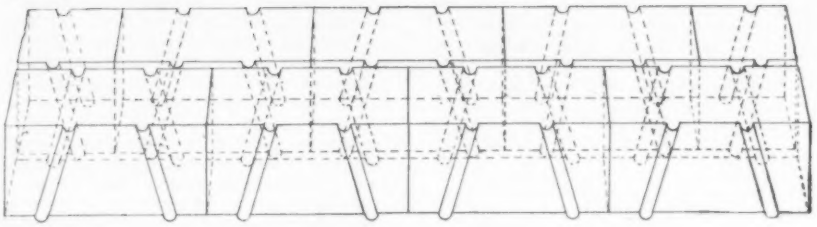


Fig. 1

STREET PAVEMENT OF DUNN'S WIRE-CUT LUG BRICK.

during the process of rearrangement in the press, thus reducing its cohesion and, when the oil is burned out, increasing the porosity of the brick. The cnosiderable proportion of waste in the repress carries the oil back with it to the mixing pan and slightly taints a considerable amount of the clay. The manufacturer has the disadvantage of a greater percentage of seconds and culls in burning repressed brick, thus increasing the cost.

Mr. Frank B. Dunn, of Conneaut, O., who is prominent in the brick trade, has invented a very simple device for securing the advantages of the repressed brick at the same time that he retains the advantages of the wire-cut brick. It is in the shape of rigid or roll guides attached to the platen of the cutting table above and below the column of clay, and projecting over the line of travel of the cutting wires as they pass through the ribbon of clay, deflecting them slightly so as to form ribs or lugs across the sides of the bricks, which are, evidently, side cut, and corresponding grooves in the adjoining sides of the next bricks. These grooves can be removed, if desired, by extra wires cutting the grooved sides down plane, but this is not necessary, nor, indeed, really advisable.

The position and form of lugs depends on the position and form of the guides and the style of cutting table used. Various forms are shown in Figures 2, 3, and 4. Probably the most satisfactory form for brick street paving is that shown in Fig. 3, two rows of which are shown in Fig. 1, showing the breaking of joints and the intersection of lugs and grooves in such manner as to keep the bricks at exact distances apart and facilitate the flow of the joint filler to all parts of the joint. Owing to the sag of the cutting wires when drawn through the clay, the lug is slightly thinner near the middle than at the ends, still further aiding in the proper placing of the filler.

For sidewalks, private driveways or country roads where filler cost must be reduced to a minimum, and little or no curb can be afforded, the vertical grooves, shown in Fig. 4, may be used. As shown, the bricks break joint and at the same time the lugs fill the grooves so that the paving blocks are interlocked and side motion is prevented.

Bricks made by Mr. Dunn's process have the desirable square edges, uniform thickness of lugs, wire-cut surface on the side receiving the filler, and greater density of the wire-cut brick, and if laid according to the best specifications they produce a pavement smooth from the beginning, immovable, durable, permanent.

If the manufacturer wants his name or brand on the bricks, it can be put on the ends of the brick by means of a roller as the clay ribbon emerges from the die.

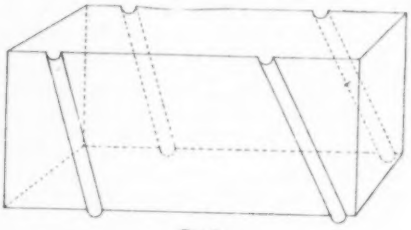


Fig. 2.

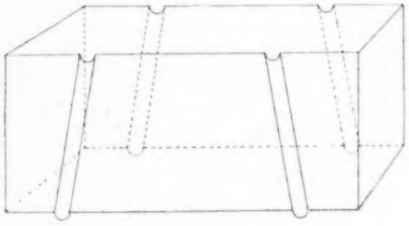


Fig. 3.

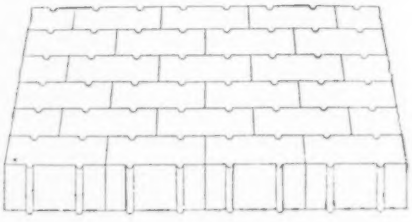


Fig. 4.

DUNN'S WIRE-CUT LUG BRICK, SHOWING VARIOUS FORMS OF LUGS.

Mr. Dunn's patents cover the method of deflecting the wires on the cutting table and also any wire-cut lug or rib on a

brick. He is ready to contract with manufacturers of first-class paving brick for license to make brick according to his process, and our readers can soon have them for the construction under their charge by writing to Mr. Dunn and expressing their desires. He has made many of the bricks in his own factory and knows by actual test that his claims for the process are well founded.

Sea Water Tests of Concrete at the Navy Yard, Charlestown, Mass.

The conditions of the tests to be undertaken by the Aberthaw Construction Co., of Boston, under the supervision of the Navy Department, at the Charlestown navy yard, have now been perfected. Mr. Herbert L. Sherman, cement chemist, of Boston, will assist. The object of these tests is to determine the effect of sea water upon concrete, both as regards climatic conditions and chemical action. The specimens will be built in molds in the sea, properly erected for easy inspection and for photographing, and so marked as to be easily identified. A careful record of the materials and the methods used is to be kept for each specimen. The piers will be 16 inches square and 16 feet long, so placed that the lower 2 feet will be permanently immersed in sea water, and that the top will probably never be immersed. There are to be twenty-four piers. In the first series of specimens a standard average composition Portland cement will be used throughout, which shall pass the standard specifications of the American Society of Testing Materials, as required by the Navy Department. In the making of other specimens Portland cement will be selected for various characteristics; some will be entirely free from iron; other lots will be high in alumina or low in alumina. Some iron ore cement will be used which is practically free from alumina; slag cement will also be employed. Various proportions of cement, sand and stone will be used, some mixed quite dry; others with sufficient water to make the concrete plastic, and still others will be mixed very wet.

Special conditions of mixing will be provided for certain specimens. In one case the mixing will be much better than ordinary commercial mixing; in others sea water will be employed; hydrated lime, Sylvester mortar and clay will also be used.

Another series of specimens will consist of 15 cubes 6 inches on a side of specified composition. One-third of these, after being thoroughly wet, will be immersed in sea water; another third will be supported at about half tide, and the rest will be kept perfectly dry, but exposed to the water. In addition, briquettes will be made of the same cement and proportions of mortar as used for the large specimens. These will be held subject to tests at intervals marking a period of years. They will be exposed in different ways and serve as a basis for tests of strength. All cement will be tested for physical and chemical properties. The same tests will be applied to the stone. The exact nature of the various ingredients such as sea water, hydrated lime, Sylvester mortar and clay will be determined. The specifications go into considerable detail regarding the methods of mixing, building forms, reinforcing, testing, etc.

The results of these tests will certainly be awaited with much interest, and they will be reported upon from time to time.

Validity of Warren Bitulithic Patents Sustained.

The suit brought against the city of Owosso, Mich., by Warren Brothers Company for infringement of the Warren patents on bitulithic pavement by a pavement laid for that city by the Barber Asphalt Paving Company, which was decided in favor of the city in the United States District Court of Eastern Michigan, was appealed to the United States Court of Appeals, Sixth Circuit, and decision was rendered by that court January 5, 1909.

The full text of the opinion has been published and can be obtained on application to Warren Brothers Company, Boston, Mass. It goes in detail into the descriptions of the patents and the claims at issue, which include the forms covering a street pavement of graded sizes of ingredients mixed to produce a mineral structure of inherent stability with less than 21 per cent of voids filled with a soft bituminous binder.

It describes the various forms of pavement, particularly macadam and asphalt, and shows how Warren's invention differs from them. It states that no serious effort was made in presenting the case to show anticipations, the main reliance being upon an experimental sidewalk laid in 1896, which appears to have been abandoned so far as further construction on the same lines is concerned; upon the use of similar mixtures for reservoir linings not intended for pavements; and upon a floor and an asphalt concrete foundation for machinery. All were experiments, none, except the sidewalk, having the remotest relation to street pavements; and the terms of an English patent on an improvement in asphaltic pavements, issued to Clifford Richardson, are held to indicate that the theory of the construction of the sidewalk, so far as it may have had a theory, was quite the opposite of that underlying the Warren patents. The fact that no street pavement was shown to have been laid according to Warner's plan prior to his invention, leads to the opinion that proof of anticipation is not strong enough to deprive Mr. Warren of his invention. The same is true of patents relied upon as evidence of anticipation, the descriptions being so vague and

indefinite that they cannot be construed as similar to the clear and detailed instructions and descriptions given in the Warren patents.

The opinion states that three of the claims quoted in the decision are infringed. The fourth, covering comparatively soft bitumen binder, had no proof of infringement as it was not shown that the binder used in the pavement complained of answered this description.

The decree of the lower court was therefore reversed and the case remanded to the lower court for an accounting.

Trade Publications.

Catalog 67D of the Jeffrey Mfg. Co., Columbus, O., is devoted to the Jeffrey Century Rubber Belt Conveying Machinery.

Bulletin 158 of the B. F. Sturtevant Co., describes their multivane fan.

Eck motors are the subjects of bulletins 39 and 40 of the Eck Dynamo and Motor Co.

The Waterloo Cement Machinery Corporation of Waterloo, Iowa, which has recently purchased the business of the Waterloo Cement Machinery Co., is issuing an attractive booklet descriptive of the Polygon concrete mixer, which should be in the hands of every one who mixes concrete. It gives a very good description of the construction of the Polygon as well as explaining the process of mixing concrete with this machine. It also contains some reference tables of value. Under the management of the new company the popular Polygon mixer will enjoy an even more extensive sale than heretofore. The new company is extending its plant and equipment and is adding to the well-known Polygon line of cement machinery a loading device for concrete mixers and also a hoist for elevating concrete to the upper stories of buildings. They state also that they will carry a full stock of everything in their line and will be in position to fill orders promptly. Anyone in the market for equipment will do well to write them.

David Lupton's Sons Co., Philadelphia, issue a catalog devoted to the Pond device for operating long rows of swinging windows like those in the louvers of a factory.

A recent circular of the Wm. G. Hartrauft Cement Co., Philadelphia, Pa., gives some handsome illustrations of manufacturing plants, power plants and dams in the South in the construction of which thousands of barrels of Old Dominion Portland cement were used.

Calendars have been received from the Universal Portland Cement Co.; Winnipeg Development and Investment Bureau; W. B. Conkey Co., Chicago; Atlas Portland Cement Co.

Ton-Industrie Zeitung's calendar is in three parts, the first a diary bound in cloth, the second a clay-worker's handbook of 400 pages, and the third a classified directory of firms in the field, covering 212 pages.

W. T. Comstock, 23 Warren street, New York City, announces a new book on "Roofing" by the well-known asphalt expert. T. Hugh Boorman, who has been engaged many years in the extension of the uses of asphalt in many directions.

Trade Notes.

ASPHALT.

Harrisburg, Pa.—Special.—W. W. Caldwell, highway commissioner, says this city contemplates purchasing a municipal plant for repairing its sheet asphalt pavements, and desires the names and addresses of firms constructing such plants.

BRICK.

Jersey City, N. J.—The Union Clay Products Co. has been incorporated by H. C. Coughlan, B. Stafford Mantz and John R. Turner.

Lincoln, Neb.—City Engineer Grant recommends a municipal plant for the manufacture of paving brick and sewer pipe.

CEMENT.

Denver, Colo.—The Denver & Northwestern Portland Cement Co. has been incorporated and construction of the proposed plant will begin about March 15. The officers of the company are: President, W. S. Campbell; vice-president, J. B. Church; secretary, G. N. Robinson; chemist, Prof. H. Fleck, of the State School of Mines.

New York City.—The Hydrolithic Cement Co. has been incorporated to manufacture natural and artificial cement, artificial stone, etc., by Benjamin F. Russell, Arthur W. Britton and Samuel B. Howard, 37 Wall street.

Union City, Mich.—The Peerless Portland Cement Company of this city, has built a mammoth cement chimney with steel reinforcement, with such success that other work will now be done, including a large cement storage building.

The Superior Portland Cement Co., which makes the Superior brand of Portland cement at Superior, O., has removed its offices from Charleston, W. Va., to the Union Trust building, Cincinnati, O. This location is nearer to the trade and will enable the company to handle its growing business more easily.

F. L. Smidth & Co., one of the oldest firms in the manufacture of cement machinery, which is used in all parts of the world, have removed their offices to the fourth floor of the Fulton building, Hudson terminal, at the corner of Fulton and Church streets, New York City. Their new quarters are much more commodious and are better located.

CONCRETE BLOCKS.

Mitchell, S. D.—Archie Hillyard, of Spencer, Ia., will establish a cement tile plant here.

Foley, Minn.—F. J. Kotsmith will begin the manufacture of cement blocks in the spring.

PURCHASE OF MACHINERY.

Lake Mohonk, N. Y.—Special.—George H. Young desires information regarding machinery used in digging, suitable for rock, too.

Chicago, Ill.—Special.—The Citizens' Construction Co., 805 Chamber of Commerce, is in the market for machinery and

tools for street paving and a concrete mixer.

Harrisburg, Pa.—Special.—W. W. Caldwell, commissioner city highway department, says this city is considering the purchase of a municipal plant for repairing its sheet asphalt pavement.

Bluffton, Ind.—Special.—C. L. Brineman, 422 West South street, desires to purchase a road grader.

Montgomery, Ala.—Special. — Howard Butt, 121 Sayre street, desires to purchase a transit and drawing materials.

Fargo, N. D.—Special.—H. E. Allen advises us that he desires to purchase wheel barrows and yellow metal tools for sidewalk work.

Springfield, Mass.—Special.—Joseph Misino & Sons, 81 Wilcox street, is in the market for machinery and tools for excavating and grading, road building and sewers.

Franklin, Pa.—All of the property, corporate rights and franchises of the Franklin Rolling Mill & Foundry Co., all real estate owned by the company and all buildings thereon and constituting a rolling mill plant, will be sold at receiver's sale at 10 a. m. February 1. Edward E. Hughes, receiver.

PURCHASE OF MATERIALS.

Soringfield, Mass.—Special.—Joseph Misino & Sons, 81 Wilcox street, is in the market for reinforced concrete, etc.

Bluffton, Ind.—Special.—C. L. Brineman, 422 West South street, desires to purchase cement and sewer tile.

Chicago, Ill. — Special. — The Citizens' Construction Co., 805 Chamber of Commerce, is in the market for granite blocks, creosoted blocks and brick.

MISCELLANEOUS.

Muncie, Ind.—The Muncie Stone & Lime Co. has been incorporated to deal in stone and lime, by C. F. Headington, E. T. Milligan and J. B. Milligan.

New York City.—Special.—The Power Specialty Co., 111 Broadway, builders of the Foster Superheated and Heenan Refuse Destructor, has closed contracts for the following: Superheaters: American Wood Extract Co., several orders; Canal Lumber Co., Myers, Standard and Stearns Lumber Companies, Washington and California, separately fired units; Isthmian Canal Commission, 4800 h. p. in Keeler boilers; Philadelphia Navy Yard, 1800 h.p. in Edge Moor boilers; Boston Navy Yard, 900 h. p. in B. & W. boilers and 700 h. p. in A. & T. boilers; Oakland Gas & Electric Co., 6,000 h. p. in McNaull boilers; Nich- MUNIC ENGR—17 17 ols Copper Co., 2,300 h. p. separately fired united. Destructors: In addition to the Heenan Refuse Destructor contracts recently mentioned, this company has just been advised that proposals to the city of Portsmouth, England, covering two Heenan Destructors, each of 100 tons daily capacity, have been accepted.

The Power Specialty Co., 111 Broadway, New York City, reports that a contract for a Heenan refuse destructor of 60 tons daily capacity, complete with water tube boilers, superheaters, clinker crushing machinery and buildings for Adelaide, New South Wales, has just been awarded; also one for a 50-ton plant for Penang, Strait Settlements.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

CONTEMPLATED WORK.

Atlanta, Ga.—Paving is urged for Marietta st.

Rome, Ga.—Paving is contemplated for Broad st.

Dubuque, Ia.—Tarvia paving is proposed for Grandview av. this year.

Little Rock, Ark.—Brick paving is contemplated for Water st.

Atlantic, Ia.—The question of paving some of the principal streets is being agitated.

Iowa City, Ia.—Brick and bitulithic paving is contemplated for various streets.

Mobile, Ala.—The paving of Davis ave. from Claiborne to Wilkinson is proposed.

Spring City, Pa.—Paving has been decided upon for Mawr st., from Bridge to Chestnut sts.

Knoxville, Tenn.—Brick or granitoid paving has been petitioned for in E. Jackson st.

Grinnell, Ia.—Special.—H. P. Simmon advises us that some brick paving is contemplated this year.

Jefferson, O.—The county commissioners have voted to issue $34,000 bonds for improving 4 mi. of highways.

Bayonne, N. J.—An ordinance has been passed for asphalt paving in 37th st., from Avenue A to Avenue E.

Paris, Tex.—The Texas Bitulithic Co. has completed plans for paving the public square. J. W. Croak, cy. engr.

Springfield, Ill.—Specifications are being prepared for paving 3rd st. from Dodge st. to Black ave. Cy engr. Hamilton.

Walla Walla, Wash.—The construction of petrolithic roads for country lanes is recommended by G. W. Winkle, co. surv.

Newark, N. J.—Brick, bitulithic, bituminous macadam and wood block paving is contemplated for a large number of streets.

Cadillac, Mich.—Plans, specifications and estimates will be prepared for grading, claying, graveling, grading and macadamizing Pine and Lincoln sts.

Aberdeen, S. D.—A resolution has been adopted providing for about 14 blocks of paving in Main st., in the business portion of the city.

Buffalo, N. Y.—Special.—Plans will be prepared and bids asked for repaving Elmwood ave., from Frost ave. to Scajaquada creek, about 1,500 ft.

Columbia, S. C.—City council has appropriated $81,700 for paving, $3,000 for sewers, and $21,000 for maintenance of streets. A. W. Edens, cy engr.

Atchison, Kas.—Resolutions have been adopted providing for 8,540 sq. yds. of brick paving and 5,000 lin. ft. of cement curb and gutter. Chas. A. Howk, cy. clk.

Des Moines, Ia.—Petitions have been submitted to the council asking for the paving of 6 or 7 blocks of Cottage Grove ave. The city council voted to pave 44th st. with asphalt.

Elizabeth, N. J.—Special.—Edward L. Faughnan, 828 Grove st., advises us that he desires to purchase machinery and tools for water, gas works, sewerage and street paving.

Vincennes, Ind.—Concrete sidewalks and stone curbing in Buntin st., the improving of 11th st., and the grading of the square from Crane to Willow sts., is contemplated.

New Castle, Pa.—Plans have been prepared for 30,000 sq. yds. of paving on concrete base on Elm st., and 1,000 lin. ft. of sandstone curb. C. H. Milholland, cy engr.

Davenport, Ia.—Grading, paving and curbing is contemplated, including the following: Brick, Ripley and Warren sts.; mineral rubber, Sylvan ave.; asphalt, Rusholme st.

Topeka, Kas.—Plans are being prepared for constructing about 60 blocks of 2-course block pavement on sand foundation, with combined cement curb and gutter. C. B. Burge, cy. clk.

Elgin, Ill.—Bids will probably be asked in April for 27,985 sq. yds. of brick paving, 3,679 sq. yds. of asphalt paving, 13,000 cu. yds. of excavation, and 12,500 lin. ft. of curb and gutter. C. E. Plum, cy. engr.

CONTRACTS TO BE LET.

Delphi, Ind.—Bids are asked until Feb. 1 for constructing 3 gravel roads. Co. comrs.

Crown Point, Ind.—Bids are asked until Feb. 1 for constructing 2 gravel roads. Co. comrs.

Paoli, Ind.—Bids are asked until Feb. 2 for constructing a road. Alvin B. Ham, co. audt.

Spencer, Ind.—Bids are asked until Feb. 18 for building gravel roads. Geo. W. Edwards, co. audt.

Tipton, Ind.—Bids are asked until Feb. 5 for constructing 3 gravel roads. J. F. Barlow, co. audt.

Spencer, Ind.—Bids are asked until Feb. 18 for constructing a gravel road. Geo. W. Edwards, co. audt.

Bluffton, Ind.—Bids are asked until Feb. 3 and 4 for constructing stone roads. O. D. Garrett, co. audt.

Anderson, Ind.—Bids are asked until Feb. 5 for constructing a gravel road. W. T. Richards, co. audt.

Rockville, Ind.—Bids are asked until Feb. 4 for constructing a gravel road. H. A. Henderson, co. audt.

Kokomo, Ind.—Bids are asked until Feb. 3 for constructing gravel roads. A. B. Easterling, co. audt.

Vincennes, Ind.—Bids are asked until Feb. 2 for constructing a gravel road. John T. Scott, co. audt.

Franklin, Ind.—Bids are asked until Feb. 8 for constructing a gravel road. W. B. Jennings, co. audt.

Fowler, Ind.—Bids are asked until Feb. 12 for constructing gravel roads. Lemuel Shipman, co. audt.

Laporte, Ind.—Bids are asked until Feb. 4 for constructing 2 macadam roads. Chas. H. Miller, co. audt.

Frankfort, Ind.—Bids are asked until Feb. 4 for constructing gravel roads. Chas. F. Cromwell, co. audt.

Logansport, Ind.—Bids are asked until Feb. 3 for constructing macadamized roads. Geo. W. Cann, co. audt.

New Albany, Ind.—Bids are asked until Feb. 6 for paving Locust st. with brick or granitoid. Cy. engr. Mann.

St. Louis, Mo.—Bids are asked until Feb. 5 for paving various streets and alleys. W. B. Dryden, secy. B. P. I.

Lebanon, Ind.—Bids are aasked until Feb. 5 for constructing 9,160 ft. of gravel road. B. F. Herdrich, co. audt.

Valparaiso, Ind.—Bids are asked until Feb. 2 for constructing gravel or stone roads. Stephen F. Corboy, co. audt.

Vevay, Ind.—Bids are asked until 1 p. m., Feb. 1, for constructing a gravel road. Scott Culbertson, co. audt.

Bloomfield, Ind.—Bids are asked until Mar. 2 for constructing a gravel and macadamized road. Peter M. Cook, co. audt.

St. Paul, Minn.—Bids are asked until Feb. 15 for graveling or macadamizing Bald Eagle av. Edw. G. Krahmer, co. audt.

Lake Village, Ark.—Bids are asked until Feb. 20 for constructing 13,000 sq. ft. of concrete sidewalk. Hermon Carlton, secy.

Muncie, Ind.—Bids are asked until Feb. 3 for paving 2 highways with crushed stone and 1 highway with brick. Co. comrs.

Cleveland, O.—Sealed bids are asked until Feb. 3 for grading, draining and improving Columbia road. A. B. Lea, co. surv.

Fond du Lac, Wis.—Bids are asked until Feb. 10 for constructing 8,000 sq. yds. of asphalt and 55,000 sq. yds. of cement paving. E. W. Clark, mayor.

Paris, Ill.—Bids are asked until Feb. 15 for constructing 21,000 sq. yds. of brick paving. Wm. Blackman, engr.; Walter Logan, clk. bd. impvts.

Whipple Barracks, Ariz.—Bids are asked until Feb. 15 for constructing concrete walks around and from 11 sets of officers' quarters to the main walk. Lieut. K. P. Williams, A. Q. M.

Buffalo, N. Y.—Bids are asked until Feb. 4 for paving and filling in Hamburg turnpike and constructing a sidewalk from Buffalo creek to the city line. Francis G. Ward, comr. pub. wks.

Indianola, Ia.—Bids are asked until Feb. 8 for constructing 15,390 sq. yds. of creosoted wood block paving, 7,884 lin. ft. of concrete curb and 450 cu. yds. of extra grading. Arthur Lee, cy. clk.

CONTRACTS AWARDED.

Youngstown, O.—James McCarron was awarded the contract for paving West ave., for $13,306.

Jeffersonville, Ind.—The contract for improving 6th st. was awarded to Thos. F. O'Neil, for $7,069.

Vincennes, Ind.—The contract for constructing gravel roads was awarded to Louis Phillippe, for $5,880.

Gadsden, Ala.—The contract for constructing 5,000 sq. yds. of cement sidewalks was awarded to C. O. Duncan.

Hartford City, Ind.—The contract for constructing 2 macadam roads was awarded to Garrett & Brenneman, of Bluffton, Ind., for $1,800.

Shenandoah, Ia.—The contract for 7,000

sq. yds. of brick paving was awarded to Rankin & Schwartz, of this city, at $1.80 a sq. yd.

Jersey City, N. J.—The contract for constructing 1,814 sq. yds of brick paving was awarded to the J. F. Shanley Co., 26 Exchange Place.

Jenkintown, Pa.—The contract for constructing about 3 mi. of streets was awarded to Morris W. Wolff, of Glenside, Pa., for $55,000.

Hillsdale, N. J.—The contract for macadamizing and grading Hillsdale twp. was awarded to H. B. Sproul, of Binghamton, N. Y., for $35,897.

Flemington, N. J.—VanKeuren & Son, of Newark, N. J., secured the contract for constructing a macadamized road about 6 mi. long, for $39,887.

Scranton, Pa.—The contract for paving Green st., Webster, Quincy, Railroad, 7th and 4th aves. was awarded to R. C. Ruthven, of Buffalo, N. Y.

Buffalo, N. Y.—Special.—The contract for paving Kentucky st. with brick on macadam base was awarded to F. V. E. Bardol, 400 D. S. Morgan bldg.

Pasadena, Cal.—Contracts for improving streets have been awarded as follows: El Molino av., George Oswald, $6,300; Cedar st., Thompson & Dontanville.

New Orleans, La.—The contract for paving Calliope st., with granite block was awarded to W. H. Douglass, for $20,998, and to W. J. Commerford, for $59,713.

Williamsport, Ind.—Contracts for constructing gravel roads have been awarded as follows: Wm. Peterson, Bluffton, Ind., $3,013.13; W. H. Fatout, Indianapolis, Ind., $7,184; W. O. Thomason, Bluffton, Ind., $4,965; James Parlon, Lafayette, Ind., $4,600.

Bluffton, Ind.—Contracts for constructing gravel roads have been awarded as follows: Wm. Reppert, 4 roads, $22,274; Eli Engle, 2 roads, $16,122; L. Hutsell, 2 roads, $13,703; J. N. Kohn, 1 road, $4,766.55; C. C. Cole, 1 road, $7,600; J. Gordon, 1 road, $2,399; G. W. Taber, 1 road, $2,596.60; T. Turpin, 1 road, $1,647; M. Alexander, 1 road, $3,595.

Long Island City (L. I.), N. Y.—The Phoenix Construction Co., 41 Park Row, New York City, was awarded the contract, Dec. 30, for repaving with granite blocks the College Point Causeway, for $30,079. The Astoria Contracting Co., Astoria, N. Y., was awarded the contract for grading, curbing and constructing bluestone sidewalks in Potter and 11th aves., for $15,318.

Genoa, O.—Special.—Crawford & Tarbell, producers of crushed stone and general contractors, advise us that they have about $50,000 worth of contracts in Wood and Ottawa counties, Ohio, which will keep their plant busy all next year. They are thinking of increasing the capacity of the plant in order to enable them to handle more business.

New Orleans, La.—Paving contracts have been awarded as follows: Barber Asphalt Paving Co., 205 Chartres st., Octavia, Carondelet, Scott, South Solomon and South Pierce sts., with asphalt; Etta Contracting Co., Ltd., Bienville and Dryades st., with granite block; W. H. Douglas, South Franklin and Soniat sts., with bitulithic; Southern Bitulithic Co., Hibernia Bank bldg., Esplanade av., with bitulithic; R. S. Blome & Co., Chicago, Ill., Cortez st., with granitoid.

Philadelphia, Pa.—Contracts for repairing and maintaining the streets of this city during 1909 were awarded Jan. 7, as follows: For maintenance of unpaved and macadamized roads, small bridges and sprinkling thereof, to David McMahon, Main and Chelten aves., at $67,400; for repairs to paved streets, except asphalt, not occupied by railway tracks, divided among the McNichol Paving & Construction Co., Betz bldg., Cunningham Paving & Construction Co., and Mack Paving & Construction Co., Land Title bldg., at from 16 cts. to $1.35 a sq. yd., according to the character and extent of the work. The sum of $5,000 was appropriated for this work; for repairing streets other than asphalt occupied by railway tracks, to the McNichol Paving & Construction Co., Cunningham Paving & Construction Co. and Mack Paving & Construction Co., at from 10 to 97 cts. a sq. yd. The sum of $500,000 is available for this work; for repairs to asphalt paved streets to the Filbert Paving & Construction Co., at from 68 cts. to $1.35 per sq. yd., and for granolithic paved streets, to J. Joseph McHugh, at $1.17 per sq. yd. The Filbert Paving & Construction Co., Pennsylvania bldg., has received the contract for repairing asphalt streets occupied by railway tracks, at from 83 cts. to $1.35 a sq. yd. The award for furnishing, delivering, spreading and rolling broken stone on roads occupied by railway tracks was made to the Cunningham Paving & Construction Co., at from 12 to 97 cts. per sq. yd.

SEWERS.

Dallas, Tex.—This city has constructed 3 mi. of 6-in. sanitary sewers during 8 months of 1908, at a total cost of $7,700.

CONTEMPLATED WORK.

Eveleth, Minn.—A sewer in Grant st. is proposed.

Berkeley, Cal.—A new storm water sewer system is contemplated here.

Houtzdale, Pa.—The construction of a sewerage system is contemplated.

Winchester, Va.—Voted to issue bonds for constructing a sewerage system.

Vicksburg, Miss.—A drainage system is contemplated at Tallulah.

Topeka, Kas.—Plans are being prepared for constructing the new Kenwood sewer.

Lorain, O.—Plans have been completed for constructing the East Erie ave. sewer.

Sharon, Pa.—The question of constructing a sewage disposal plant is being discussed.

Baltimore, Md.—The construction of a storm water drain in Eastern ave. is contemplated.

Taunton, Mass.—The mayor has recommended an appropriation of $15,000 for sewer laterals.

Putnam, Conn.—The mayor recommends the installation of an adequate sewerage system.

Missoula, Mont.—Surveys for a sanitary sewer system are being made by W. A. Mayo, cy. engr.

Hampton, Va.—Voted Jan. 5 to issue $100,000 bonds for improving the streets and sewerage system.

Woodlawn (Birmingham P. O.), Ala.—Voted to issue bonds for extending the sewerage system.

Bryan, Tex.—The construction of a sewerage system is contemplated. J. T. Malont, mayor.

New Toronto, Ont.—Plans are being prepared for installing a sewerage system in this township.

Enid, Ok.—Special.—F. W. Brooks, 831 E. Broadway, is in the market for about 30 mis. of pipe.

Utica, N. Y.—Plans are being prepared for constructing a storm water sewer about 5,000 ft. long.

Aurora, Ill.—Plans are about completed for 30,000 ft. of sewer extensions in the 3rd and 4th wards.

Newburgh, N. Y.—Bids will be received about Mar. 2 for constructing a sewer in Robinson av. with laterals.

Pittsburg, Pa.—Plans will be prepared for constructing a main sewer in the West End. N. S. Sprague, cy. engr.

Carlstadt, N. J.—This borough voted Jan. 13 to install a complete sewerage system at a cost of about $80,000.

Baltimore, Md.—The sewerage commission is about ready to begin the construction of latheral sewers throughout this city.

Elizabeth, N. J.—Special.—Edward L. Faughnan, 829 Grove st., desires to purchase machinery and tools for sewerage, etc.

Edwardsville, Pa.—An ordinance has been passed for constructing a sewerage system in Myers st. Wm. I. Williams, Burgess.

Wyandotte, Mich.—Plans, specifications and estimates will be prepared for constructing sewers in West Wyandotte, by Mason L. Brown.

Rock Island, Ill.—The bd. of local impvts. voted, Jan. 6, to construct a sewer system in the 6th ward. Wallace Treichler, cy. engr.

Fulton, N. Y.—The state department of health has approved plans for constructing the disposal plant for the West Side sewer system.

Ann Arbor, Mich. — City Engineer Groves has completed plans for establishing sewer districts in S. Main, Arch and Thayer sts.

Whittier, Cal.—A resolution has been adopted calling for a special election in February to vote $110,000 bonds for a seewrage system.

Asbury Park, N. J.—Plans have been completed for installing a septic system for the disposal of sewage. John L. Coffin, supt. water and sewers.

Moline, Ill.—Bids will probably be asked the latter part of January or first of February for constructing the 6th ward sewer. Clark G. Anderson, cy. engr.

San Francisco, Cal.—Specifications are about completed for constructing 11 mis. of sewers in the Prospect Hill Improvement district. F. M. Girard, cy. engr.

Rockville, Conn.—The mayor recommended, Jan. 4, that the special committee on sewerage filtration prepare a report and estimate of cost of constructing a sludge bed.

Madera, Cal.—Special.—This city voted, Jan. 7, to issue $25,000 bonds to acquire and add to a sewerage system owned by the Madera Sewerage Co. F. E. Smith, town mngr.

Rochester, N. Y.—Plans are about completed for building a sewer along the east river bank to Lake Ontario, to take the place of the east side sewer outlet into the river.

Buffalo, N. Y.—Special.—Plans have been ordered prepared for constructing a 24-in. brick and 15 and 12-in. tile sewer in Ashland ave., and bids will be asked soon.

Albany, Ga.—Council has adopted the plans of R. J. Edgerly, city engineer, for a sewerage system to drain Arcadia, and another sewerage system to drain the older portion of the city.

Niagara Falls, N. Y.—Special.—At a special meeting held by the bd. of public wks., Jan. 23, a resolution was adopted calling for bids until Feb. 9 for constructing an extension to the tunnel trunk sewer, about 330 ft. long.

Ipswich, S. D.—Special.—Plans for a sewerage system and sewage purification plant are being prepared by the Dakota Engineering Co., of Mitchell, S. D., and contracts will be let during the early spring.

CONTRACTS TO BE LET.

Purcell, Ok.—Bids are asked until Feb. 25 for constructing a system of sanitary sewers. M. S. Robertson, cy. clk.

Grundy Center, Ia.—Bids are asked until Mar. 8 for constructing 8 and 10-in. sewers. E. A. Cary, chm. sewer com.

Great Falls, Mont.—Bids are asked until Feb. 15 for constructing a sewer in dist. No. 55. C. W. Swearingen, cy. engr.

Brooklyn, N. Y.—Bids are asked until Feb. 3 for constructing sewers and sewer basins in various streets. Bird S. Coler, prest. boro.

College Hill, O.—Bids are asked until Feb. 3 for constructing 6 to 12-in. vitrified pipe sewers in 6 streets. F. R. Strong, vil. clk.

Detroit, Minn.—Bids are asked until Feb. 10 for constructing a system of sewers with reinforced concrete septic tank, etc. Chas. G. Sturtevant, cy. clk.

BaBnff, Alta.—Bids are asked until Feb. 5 for furnishing sewer pipe and fittings required for extensions to the sewerage system. Howard Douglas, comr. parks.

Brantford, Ont.—Bids are asked until Feb. 11 for constructing 2,250 ft. 12-in. sewer pipe, 636 ft. of 12-in. c. I. pipe, 11 manholes, etc. T. Harry Jones. cy. engr.

Toronto, Ont.—Bids are asked until Feb. 2 for constructing sec. 3 of the high level intercepting sewer, requiring 6,386 ft. of circular sewer, with manholes, etc. Jos. Oliver, mayor.

East St. Louis, Ill.—Bids are asked until Feb. 17 for constructing a system of concrete and pipe sewers, requiring 33,500 ft. of 3 to 10½ ft. drain, 5 drainage and 2 sewage pumping engines, gas engines, etc. W. J. Crocken, cy. engr.

Charleston, S. C.—Bids are asked until Feb. 2 for furnishing supplies for 1 yr., as follows: 8, 10, 12, 15, 18 and 24-in. terra cotta pipe, Ts and Ys, also laying terra cotta pipe, iron castings, bricks, lime, Rosendale and Portland cements, lumber, curbing, concrete sidewalks, crushed rock. J. H. Dingle, cy. engr.

Ottawa, Ill.—Bids are asked until Feb. 2 for constructing sewers. Jas. F. Farrell, pres. bd. local impvts.

Marion, Kan.—Bids are asked until Feb. 2 for constructing 2½ miles of main and lateral sewers in dist. No. 3. Cy. coun.

Louisville, Ky.—Bids are asked until Feb. 5 for constructing sewers. P. L. Atherton, chmn. sewerage comm.

CONTRACTS AWARDED.

Binghamton, N. Y.—John Tyne was awarded the contract for constructing the Ireland ave. sewer.

Jersey City, N. J.—The contract for constructing a sewer in Boyd ave. was awarded to O'Reilly Bros.

Springfield, Mo.—The contract for constructing district sewers in sewer district No. 12 of section 3 was awarded to J. Spandri.

San Francisco, Cal.—The contract for constructing a sewer in Amazon ave. was awarded, Jan. 15, to Williams & Belser for $12,192.28.

Bremerton, Wash.—The contract for constructing sewers in 4th, 5th, 6th and Deck sts. was awarded to N. C. Johnson of Seattle, Wash., for $8,000.

Lynn, Mass.—The contract for furnishing 2 centrifugal pumps for pumping sewage was awarded to Sampson & Allen of Lawrence, Mass., for $4,568.

Salt Lake City, Utah.—The contract for constructing sewer extension No. 219 was awarded Jan. 8 to Zerbe & Walker of this city for $936.

Dallas, Tex.—The contract for constructing a new storm sewer in Market, Calhoun and Collins sts. was awarded to George S. Vivian for $3,201.05.

Grand Rapids, Mich.—The contract for constructing a sewage pumping station at Goldbrook and Canal sts. has been awarded to Chas. E. Williams for $7,090.

Providence, R. I.—The contract for constructing 43,375 ft. of 6, 8, 12 and 15-in. pipe sewers with branches, etc., was awarded to Waldo Bros., 102 Milk st., Boston.

Muskogee, Okla.—Contracts for constructing storm sewers have been awarded as follows: Heman Construction Co., $68,-351.09; McCormick Construction Co., of St. Louis, $117,308.78.

Rye, N. Y.—The contract for furnishing all the iron manhole frames and covers needed in the construction of the new sewer system was awarded to the Globe Foundry Co. of Port Chester, N. Y.

Louisville, Ky.—The contract for constructing a sewerage system in Hoertz ave. was awarded to the Henry Bickel Co. for about $30,000. The Schultz & Vogt Construction Co. secured the contract for a sewerage system in Aubin st.

Buffalo, N. Y.—Special.—Contracts for constructing sewers have been awarded as follows: Chandler st., 18-in. tile, G. C. Waite, 83 Parkside; Amelia and Germania sts., Geo. Moore, 177 Elk st.; Wyoming ave., W. G. Smith, 1083 Elmwood ave.

WATER WORKS.

Plattsmouth, Neb.—The Plattsmouth Water Co. has elected the following officers: President, M. M. Gifford, Prophetstown, Mass.; secretary, T. H. Pollock, Plattsmouth; treasurer, B. Q. Bond, Rochester, N. H.

CONTEMPLATED WORK.

Winona, Minn.—A filtration plant is proposed.

Kearney, Neb.—A water works system is proposed.

Mount Ayr, Ia.—A water works system is contemplated.

Bottineau, N. D.—A water works system is contemplated.

Salem, Ind.—This town will enlarge the water works system.

Hamlin, Tex.—Voted to issue bonds for constructing water works.

Mankato, Minn.—The extension of the water mains is contemplated.

Put-in-Bay, O.—Voted to issue bonds for constructing a water works.

Kennard, Neb.—The construction of a water works system is proposed.

Kadoka, S. D.—A municipal water works is contemplated here.

Shrewsbury, Pa.—The establishment of a water works plant is under consideration.

Sparta, Wis.—The question of constructing a water works system is contemplated.

High Point, N. C.—A filter plant is contemplated. W. D. Alexander, supt. w. w.

Allen, Neb.—The question of constructing a water works system will be voted on.

Barberton, O.—The purchase of a new air compressor for the water works is proposed.

Araphoe, Neb.—Will vote on the issue of bonds for constructing a water works system.

Orange, Va.—Plans are being prepared for constructing a water works system.

Dudley, Mass.—Plans and estimates have been prepared for constructing a water works system.

St. Louis, Mo.—An ordinance has been approved providing for the extension of the water mains.

Jackson, Minn.—Bonds have been voted for a steel water tower and extending the present water system.

Southboro, Mass.—Surveys, plans and estimates have been prepared for constructing a water works system.

Stevensville, Mont.—Voted to issue bonds for constructing a water works system. Geo. T. Boggs, cy. clk.

Carl Junction, Mo.—Voted to issue bonds for constructing a water works system. Willis G. Clark, cy. engr.

Bowling Green, Ky.—Special.—R. C. P. Thomas says the filtration of the water supply is contemplated.

Aberdeen, Wash.—The estimated cost of constructing an 8-in. water main across the Chehalis river is $4,000.

Norton, Kan.—About $15,000 to $18,-000 will be expended for water works improvements. R. W. Hemphill, cy. clk.

Spooner, Minn.—Bids will be received in the spring for constructing a water works system. C. H. Dodds, vil. clk.

Mt. Morris, N. Y.—Plans and specifications for a new water works system will be made by J. F. Witmer of Buffalo.

North Arlington (Arlington P. O.), N. J.—Plans for a water works system will be prepared by Wise & Watson of Rutherford.

Lincoln, Neb.—Plans for a 1,000,000-gal. reservoir at the Mockett pumping station will be prepared by the city engineer.

Elizabeth, N. J.—Special.—Edward L. Faughnan, 829 Grove st., desires to purchase machinery and tools for water, gas, etc.

Winchendon, Mass.—The residents of Elmwood road are circulating a petition asking that water mains be laid in that district.

Clearwater, Cal.—Bids will be received about Mar. 1 for constructing a water works and sewerage system. Leroy Brandon, mayor.

Auburn, Neb.—The election to vote on the issue of bonds for constructing a water works system has been postponed until Mar. 2.

Cleveland, Tenn.—A resolution has been passed favoring the issue of bonds for the purchase of the existing water works system.

Minneapolis, Minn.—The residents of Oliver Park will ask for the extension of the water mains to that district in the spring.

Glasgow, Mont.—Voted to issue $50,-000 for constructing a water works system. Bids for the bonds will be received Mar. 12. H. C. Allen, cy. engr.

Lake Mohonk, N. Y.—Special.—Geo. H. Young advises us that he is interested in any matter which pertains to the laying of about 8 miles of c. i. water pipe.

Lake Village, Ark.—Special.—Herman Carlton says bids will be asked for a $30,-000 water plant as soon as the specifications are received from the engineers.

Madera, Cal.—Special.—F. E. Smith, town engineer, says the question of issuing $50,000 bonds to construct a municipal water supply system was favorably voted on.

Alton, Ill.—The Alton Water Co. has informed Mayor Beall of its intention to

install a new pump in its pumping station, build a standpipe and extend its mains.

Uniontown, Ky.—Plans and estimates for water works will be made by E. B. Shiffley, cy. engr., and Asa Williams of Owensboro. They desire catalogs of motor-driven centrifugal pumps, fire hydrants and water gates.

London, Ont.—The question of expending about $441,000 to increase the water supply, including the taking in of the Kilworth supply, the erection of a pumping station in the north end of the city, etc., may be voted on.

Selby, S. D.—Special.—Plans for a complete municipal water works system are being prepared by the Dakota Engineering Co., of Mitchell, S. D. Bids for a 10-in. well 300 to 2,000 ft. deep will be asked soon and the contracts for the work will be let when the well is completed.

Montgomery, Ala. — Special. — Howard Butt, C. E., 121 Sayre st., has been engaged as engineer to construct the water and light system at Samson, Ala., and with W. W. Graham, mayor of Samson, desires to correspond with bond companies regarding the selling of $25,000 water and light bonds. Mr. Butt also desires to correspond with manufacturers of water and light supplies.

CONTRACTS TO BE LET.

Mabton, Wash.—Bids are asked until Feb. 23 for constructing a water works system.

Hugo, Okla.—Bids are asked until Feb. 2 for constructing a water works plant. W. T. Echols, clk.

Phoenix, Ariz.—Bids are asked until Feb. 10 for a pumping engine. Robert A. Craig, supt. w. w.

Sebree, Ky.—Bids are asked until Feb. 15 for constructing a water works system. C. H. Ramsey, mayor.

Wichita, Kan.—Bids are asked until Mar. 15 for constructing a water works system. R. N. Dorr, cy. clk.

Edgemont, S. D.—Bids are asked until Feb. 8 for constructing a water works system. C. A. Hardy, cy. audt.

Minot, N. D.—Bids are asked until Feb. 4 for constructing a municipal water works plant. E. S. Severance, cy. engr.

Kenosha, Wis.—Bids are asked until 12 p. m. for Feb. 2 for building and erecting a pumping engine. R. H. Moth, supt. water comrs.

Grinnell, Ia.—Special.—H. P. Simmon says bids will be received about Mar. 8 for 1 pressure pump of 1,000 gal. per minute capacity.

Richland Center, Wis.—Bids are asked until 8 p. m. Feb. 2 for furnishing a 400-gal. triplex power pump. Reuben Sutton, cy. clk.

Winnipeg, Man.—Bids are asked until Feb. 22 for furnishing and erecting a turbine pump with electric motor for the water works system. H. N. Ruttan, cy. engr.

New Ulm, Minn.—Bids are asked until Feb. 15 for constructing a covered reinforced concrete reservoir of 1,000,000 gals. capacity. H. F. Blomquist, cy. engr.; Ernst Wicherski, cy. clk.

Key West, Fla.—Bids are asked until Feb. 5 for furnishing a condenser, filter, feed water heater, etc., and for remodeling the pumping and distilling plant at Key West Barracks. Capt. C. H. Lanze, Q. M.

CONTRACTS AWARDED.

Girard, O.—The contract for constructing a water works system was awarded to the Scholl Engineering Co., of Youngstown.

Duluth, Minn.—The U. S. Cast Iron Pipe & Foundry Co. secured the contract for furnishing 1,200 tons of water and gas pipe for $31,508.

Baltimore, Md.—The A. P. Smith Mfg. Co., of Newark, N. J., secured the contract for supplying corporation cocks during 1909 for $8,894.

Hays City, Kan.—The contract for enlarging the water works system was awarded to Frank A. Huriburt & Co., of Kansas City, for $17,200.

Wellington, Kan.—The contract for a steel water tank was awarded to the Des Moines Bridge & Iron Works, of Des Moines, Ia., for $6,474.

Rockville Center, N. Y.—Louis Werner was awarded the contract for laying 350 ft. of water mains in Harrison ave. at 42½ cts. a ft.

Lockport, Ill.—A contract for a new air compressor at the water works station was awarded to the Ingersoll-Rand Co., of Chicago, for $762.

Middletown, N. Y.—The contract for installing 4 concrete filters was awarded to the New York Continental Jewell Filtration Co., 25 Broad st., New York City, for $8,565.

Eveleth, Minn.—Pastoret & Lunz, of Two Harbors, Minn., secured the contract for constructing a steel water tank and laying pipe for $12,750 and $13,136 respectively.

Holly, Colo.—The contract for installing a water works system was awarded to the W. W. Cook Co., of Junction City, Kan., and for machinery to the Mine & Smelting Supply Co. Total contract, $12,000.

Denver, Colo.—The contract for constructing irrigation ditches, tunnels and reservoirs was awarded to S. R. H. Robinson & Son Construction Co., of St. Louis, Mo., for $3,296,000. The system when completed will supply water to 130,000 acres of land in Jefferson and Weld counties.

Seattle, Wash.—The contract for constructing water mains in Crescent Drive was awarded to the International Contract Co. for $11,402, and in Lakeside ave. and other streets to the Sparger Concrete Co. for $6,782.

BRIDGES.

Granbury, Tex.—Voted to issue bonds to build a bridge across the Brazos river.

Mena, Ark.—Bids will be received until Feb. 6 for building 3 bridges. Co. comrs.

Paris, Ark.—Bids are asked until Mar. 4 for constructing a number of bridges. Fred N. Carter, co. clk.

Lawton, Okla.—Bids are asked until Feb. 9 for building a steel bridge. W. E. McGurren, chmn. co. comrs.

Corydon, Ind.—Bids are asked until Feb. 3 for constructing a bridge across Buck creek. Wm. Taylor, co. audt.

Portland, Ore.—Petitions are being circulated asking for a bridge across the Willamette river in South Portland.

Manitowoc, Wis.—Plans for a concrete bridge over the Little Manitowoc have been prepared by the city engineer.

San Bernardino, Cal.—Plans have been completed for the construction of a bridge over Lytle creek. Co. engr.

Fort Des Moines, Ia.—Bids are asked until Feb. 10 for constructing a steel highway bridge here. Constr. Q. M.

Dallas, Tex.—Definite action on the proposed lift bridge was postponed until February. E. E. Howard, cons. engr., Kansas City, Mo.

Chicopee, Mass.—The construction of a

new bridge across the Chicopeé river is recommended by W. J. Fuller, mayor, in his annual message.

Atlanta, Ga.—This city contemplates building a bridge at Gray st. to connect with the Exposition Cotton Mills district. R. M. Clayton, cy. engr.

Michigan City, Ind.—Plans are being prepared for reinforced concrete abutments with pile foundations for the 6th st. draw bridge. H. M. Miles, cy. engr.

Milwaukee, Wis.—A resolution has been introduced in the common council directing the building of a concrete bridge over Kinnickkinnic river at 6th ave.

Cincinnati, O.—Bids are asked until Feb. 5 for constructing a concrete bridge over Muddy creek at Addyston, Miami twp. Stanley Struble, pres. co. comrs.

Pittsburg, Pa.—City council has passed an ordinance providing for the sale of $1,000,000 bonds for erecting a bridge over the Allegheny river. N. S. Sprague, cy. engr.

West Seneca (Buffalo P. O.), N. Y.—The town board has approved plans for a steel bridge to be built over a branch of Buffalo river to connect Mineral Spring and Clinton st.

Boston, Mass.—Resolutions have been adopted against the War Department in its attempt to compel the Boston & Maine railroad to rebuild its bridges over the Charles river at a height of 23 ft. above the water.

Philadelphia, Pa.—The city council has passed an ordinance authorizing the construction of a bridge at Roberts ave. under the Chestnut Hill branch of the Pennsylvania railroad. Geo. R. Stearns, dir. pub. wks.

South Bend, Ind.—Petitions have been presented to the county commissioners here from Mishawaka and River Park asking that a concrete bridge be constructed across the river at Logan st. to replace the wooden structure now out of commission.

Salt Lake City, Utah.—Special.—Louis C. Kelsey, cy. engr., says the contract for constructing a highway bridge across the Jordan river at N. Temple st. was awarded, Jan. 8, to the Minneapolis Steel & Mchy. Co., of Minneapolis, Minn., for $4,192.

STREET LIGHTING.

Joliet, Ill.—Plans have been prepared for lighting the business district with electricity.

St. Louis, Mo.—Bids are asked until Feb. 5 for street lighting for 10 years. W. B. Dryden, sec. B. P. I.

Yukon, Okla.—Bids are asked until Feb. 15 for furnishing an engine, boilers, pumps, etc. Yukon Mill & Grain Co.

Chicago, Ill.—Bids are asked until Feb. 17 for constructing a municipal electric lighting plant. B. P. W.

Macon, Mo.—Special.—Voted to issue $25,000 bonds for installing an electric pump and improving the old pumping plant.

Lethbridge, Alta.—Bids are asked until Mar. 1 for constructing a municipal power plant here Geo. W. Robinson, sec.-treas.

Elizabeth, N. J.—Special.—Edward L. Faughnan, 829 Grove st., desires to purchase machinery and tools for gas works, etc.

Milwaukee, Wis.—Bids are asked until Feb. 17 for constructing a municipal electric lighting plant. Chas. J. Poetsch, chmn. B. P. W.

Lima, O.—Final plans and estimates for constructing a municipal electric light plant have been submitted to the board of public service.

Winnipeg, Man.—The contract for constructing general power works at Pointe du Bois Falls was awarded, Jan. 18, to John Gunn & Sons for $779,100.

Jamestown, N. Y.—Plans are being considered for installing a 500-k.w. steam turbine in the municipal electric light plant. Chas. G. Sundquist, mgr.

White Springs, Fla.—Bids are asked until Feb. 10 for constructing a power plant for the Suwanee River Railroad & Power Co. D. G. Ziegler & Co., Jacksonville, Fla.

La Crosse, Wis.—City council has decided to engage an expert to make investigations and decide upon the feasibility of operating a municipal electric light plant. Geo. Bradish, cy. engr.

National Soldiers' Home, Va.—Bids are asked until Feb. 10 for constructing a power house and equipment, tunnels and equipment, etc. John T. Hume, treas. Southern Branch N. H. D. V. S.

New Albany, Ind.—Special.—John H. Weathers, cy. atty., says this city will enter into a 10-year contract for electric light in June, 1910, and into a 10-year contract for furnishing gas in 1911.

Columbus Barracks (Columbus P. O.), O.—Bids are asked until Feb. 8 for furnishing and installing a transformer, etc., and making underground electric service connections, etc. Capt. H. J. Hirsch, constr. Q. M.

Cleveland, O.—Bids are asked until Feb. 5 for furnishing 8,000 16-in. boulevard glass globes, 2,000 14-in. boulevard glass globes, 140,000 gas mantles, 125,000 gallons of gasoline. W. J. Springborn, pres. B. P. S.

PARKS.

El Paso, Tex.—R. A. Harris, park comr., is planning to improve 3 new park tracts that have been donated to this city.

Knoxville, Tenn.—Mayor John M. Brooks advocates the inauguration of a system of public parks without delay.

Pierre, S. D.—The board of trade has asked the city council to investigate the matter of acquiring land for the proposed boulevard around the lake.

Hoboken, N. J.—A resolution has been adopted requesting the Hudson County Park Commissioners to expend $300,000 reserve fund in improving the parks and purchasing park sites.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Steubenville, O.—The contract for garbage removal and disposal was awarded to Howard & Smith, of this city.

Nutley, N. J.—Councilman Carr is chairman of a committee appointed to consider the question of collecting garbage and ashes.

Fort Strong (Boston P. O.), Mass.—The contract for constructing a garbage crematory was awarded to Lewis & Kitchen, of Chicago, for $3,800.

FIRE APPARATUS.

Thompson, Mont.—Fire apparatus is needed.

Bowling Green, Ky.—Special.—R. C. P. Thomas says a fire station is contemplated.